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INDEX OF VOL. V.—1886.

INDEX OF AUTHORS' NAMES.

	PAGE		PAGE
Abbe, Glass for Standard Thermometers.....	157	Arnold, C. Nitrogen Determination	617
Refractometer	157	Arth, G. Menthol Derivatives	436
Abbott, Explosives	592	Aryine, F. W. Testing Lubricants	123
Vulcanised Indiarubber	610	Asboth, Nitrogen Determination	510
Abel, C. D. Lanolin	672	Ashman, T. N. Treatment of Leather	609
Saponification	381	Ashwell, J. R. Antimony Mordant	301
Abel, Sir F. A. Carbon in Iron and Steel	493	Dyed Hosiery and Irritation of the Skin	236
Treatment of Sewage	319	Ashwell, J. H. Utilisation of Soap Suds	102
Panelastite	199	Atkinson, A. J. Estimation of Sulphur in Coal	154
Abel, Sir F. A., and Redwood B. Mineral Oil Lamps	169	Atkinson, R. W. Discussion on Alum Manufacture	22
Abel, W. F. Discussion on Filtration of Water	226	Estimation of Manganese	365
Abel and Field. Impurities in Commercial Copper	85	Japanese Method of Making White Lead	312
Abell, W. F. See Fletcher and Abell	91	Voluimetric Test for Manganese	122, 167
Actien-Gesellschaft für Anilin-Fabrikation, Berlin. Mixed Azo-colours	595	Attwood, G. Treatment of Ores	167
Adair-Roberts, F. G. See Roake	435	Anbery, J. M. See Clute	609
Adams. Determination of Butter in Milk	498	Audoynaud, A. Adulteration of Olive Oil	168
Adie. Testing Cement	197	Audoynaud, A., and Zacharewicz, E. Stable Manure	541
Aducoo, V., and Mosso, H. Saccharine as an Antiseptic	616	Austin, F. J. Disinfectors	26
Ainsworth, R. H., and Manby, E. B. Bleaching and Dyeing (illus.)	661	Anwers, H. Derivatives of Pseudo-cumol	326
Ainsworth, R. H., and Manby, S. B. Scouring and Washing Machine	609	Axenfeld, D. Reaction for Aluminium	35
Aitken, Deposition of Soot	571	Ayrton, M. Purifying Oil	510
Aitken, H. Preventing Scale in Boilers	91	Backelandt, L. Separating Columbin and Copper	471
Treatment of Ores	426	Baker, W. Coke and Tar as Fuel for Gas-producers	471
Alavoine, F. A. M. Hydraulic Mains for Gas	317	<i>Badische Anilin u. Soda Fabrik.</i> Colours from Dioxystar-taric Acid	127
Albert, H. Basic Slag as Manure	465	Baeyer and Drewsen. Indigo Derivative	320
Albert, H. and E. Potassium Phosphate as Manure	672	Baeyer and Eiehlhorn. Substance resembling Dextrin, from Lupin Seeds	385
Alexander, J. O. Relative Quantities of Sucrose and Glucose in Sugar Cane	117	Baeyer and Hemilian. Condensation Products of Secondary Aromatic Alcohols	321
Alexander, T. and S., and Paterson, R. Oil Gas	169	Baeyer and Jackson. Ethylquinoline	161
Alexander, N. A., and Ivass, L. Tanning Hides	433	Baeyer and Schiff. Pyridine	236
Allan, E. C. Filters (illus.)	521	Bagnall, J. Dissolving Indiarubber	165
Allan, E. C., and F. M. Acetic Acid Manufacture (illus.)	31	Bailey, C. J. C. Filter	415
Allen, A. H. Chemistry of Fixed Oils	65	Bailey, C. J. C., and Dean, S. C. Utilising Waste Heat of Furnaces	421
Discussion on Materials used in Dyeing	71	Bailey, W. H. Discussion on British Chemical Industries	357
Examination of Fixed Oils	282	Fusible Plugs	233
Examination of Oils	303, 191	Bailey. Discussion on Calorimeter	581
Viscometer	127	Bailly, P. Electrodes for Batteries	676
Allen, W. Acid Taps and Valves	368	Baird, F. Peat Fibre	172
Alliott, J. B. Filter Presses	169	Baker, H. M. Resorcin Blue	662
Allison, H. J. Secondary Batteries	217	Balbani. Destruction of Ova of Phylloxera	466
Amber, A. J. Employment of Hydrocarbons as Fuel	373	Balfour, J. L., and Lane, J. Gas Manufacture	522
Ambuhl and Elsner. Detection of Artificial Colour in Claret	519	Ball, C. J. Combined Gas and Vapour Force Generator	316
Amthor, C. Analysis of Alsatian Wine	497	Balkand. Alkaloids in Old Flour	171
Andersen, C. P. Hematein	609	Bread	171
Anderson. The Air of Dwellings and Schools	513	Ballard, E. G. Methyl Orange as an Indicator	287
Sulphur in Coal Gas	281	Balling, C. A. M. Antimony Production in Banya	671
Anderson, A. W. White Lead	325	Production of Antimony in Blast Furnaces	328
Anderson, G. Discussion on Utilisation of Tar	563	Balls, M. See Fromm, A.	211
André. See Berthelot	511	Balmann. Potassium Chlorate	498
Andreal, B. Gas Generator	222	Bamberger. Reactions for Orthodiketones	589
Andresen, M. Safranin and Methylene Blue	508	Bamberger, E., and Calman, A. Mixed Azo-compounds	26
Andrews. Calorimeter	382	Bamberger, E., and Philip, M. Pyrene	419, 585
Andrews, A. See Hitchingman, E. L.	195	Banister. Sucrose in Cereals	36
Andrews, C. W. See Norton	373	Bannehr, J. Treatment of Sewage	675
Angell, A. Purification of Sewage	38	Banner, S. Turpentine Substitute	522
Anschütz. Malic Acid	216	Baptiste-Régi, J., and Folie-Desjardins, C. Bisulphide of Carbon	167
Archbutt. Standard of Viscosity	131	Barbe, F. Phosphoric Acid Manure	104
Archbutt, L. Analysis of Oils	303	Barbe, M. C. P. Refined Sugar	453
Archib, J. A. See Ford, A.	671	Barbot. Examination of Oils	305
Archer, J. B. Gas from Hydrocarbons	418	Barnes, J. Gasometric Assaying (illus.)	115
Water Gas	171	Barraclough, W. Examination of Oils	283
Arducco and Mosso. Physiological Action of Saccharine	421	Barringer, R., Wallis, J. H., and Barringer, W. Laundry Blue	523
Armack, J. F. O. See Meyn	693	Barry, J. H. Treatment of Sewage Sludge	675
Armour, L. H. Writing Ink	30	Bassett. Hexachlorobenzene	232
Armstrong, H. E. Discussion on Utilisation of Tar	563	Bauer. See Classen and Bauer	39
Action of Steam on Carbonic Oxide	379	See Classen	334
Russian Turpentine	7	Bauer, H. See Stadel, W.	596
Treatment of Sulpho-acids with Steam	317	Bauer, M. Extraction of Fat	132
Discussion on Koch's Water Test	120	Hauschinger. Cements	189
Armstrong, H. E., and Miller, A. K. Hydrocarbons at High Temperatures	374	Bayer. Estimation of Alumina	550
Hydrolisation of Sulpho-acids	95	German Chemical Industries	351
Armstrong, J. T. Electrical Batteries	615, 616		

	PAGE		PAGE
Bayer and Co. See <i>Farbenfabriken</i>	427, 428	Blarez, C. Detection of Acid Magenta.....	518
Bayer, F., and Co. Methyl-violet.....	320	Blum, L. Application of the "Thomas" Slag.....	583
Bayer, K. J. Determination of Alumina.....	11	Determination of Silicon in Iron.....	502
Bayley, Estimation of Copper.....	51	Value of "Thomas" Slag as Manure.....	101
Solubility of Nitric Oxide.....	83	Blumenthal, M. Ferments.....	105
Bayley, T. Oxide of Iron.....	210	Blundstone, E. R. Utilisation of Waste Tin.....	558
Beatson, W. Recovery of Tin from Scrap.....	493	Boake, A., and Roberts, F. G. A. New Sulphite for	
Bechaux, L. Rectification of Alcohol.....	613	Brewing.....	170
Beck, P. See Will, W.....	456	Boake, A., and Roberts, F. Sulphites of Potash.....	435
Becke, M. Influence of Lime in Wool-dyeing.....	530	Boake, A., and Adair-Roberts, F. G. Disintegrants.....	161
Becker, E. Chemical Balances.....	219	Boas-Boasson, J. Oxidation of Thio-Bases of Diamines.....	672
Becker, F. Gunpowder.....	157	Brownnicki, A. Treatment of Phosphatic Slag.....	672
Beckett, Cupola with Steam Blast.....	451	Bodlander, G. Analysis of Peptone.....	617
Beckett, G. H. See Machab, W.....	267	Bodenbender, Determination of Invert Sugar.....	613
Beckles, S. H. See Punshon and Beckles.....	55	Boehm, See Rithausen und Boehm.....	243
Beckurts, H. Brucine.....	616	Boetsch, Antimony Oxalate as Mordant.....	163
Determination of Phenol.....	516, 517	Bohme, Influence of Frost on Cement.....	492
Hydrochloric Acid free from Arsenic.....	531	Strength of Cement.....	196
Permanganate as Reagent for Alkaloids.....	510	Boillot, Sterilisation of Bacteria.....	262
Bedson, P. P. Address to Newcastle Section.....	581	Bullon, Sir F. Caustic Soda Manufacture.....	91
Discussion on Magnesium Sulphate.....	585	Bolm, W. See Sweetser.....	608
Behr and Dorp. Synthesis of Anthracene.....	321	Bompas, G. G. Ship-sheathing Metal.....	85
Behrens, E. A. Bleaching Resins.....	532	Bonne, C. R. Testing Brewing Materials.....	512
Behrus, G. Filters.....	308	Borles, L. See Marchal.....	384
Belby, Discussion on Specific Heats of Gases.....	11	Borland, W. D. Granulated Antiseptics.....	219
Pyrometer.....	635	Bornstein, E., and Herzfeld, A. Oxidation of Levulose.....	197
Bein, S. Estimation of Zinc.....	519	Borstrager, A. Determination of Tartaric Acid in Lees.....	510
Belani, L. Value of Charcoal and Coke in Blast Fur-		Witt's Filtering Apparatus.....	510
naces.....	167	Borodin, Asparagin in Plants.....	385
Belcher, J. C. Determination of Glycerine.....	70	Bosse, H. Cement from Furnace Slags.....	211
Bell, Discussion on Chloride of Sulphur.....	611	Bosshard, E. See Schulze, E.....	173, 385
Bell, A. Filters.....	141	Batsch, C. Antimony Oxalate.....	293
Bell, A. J. Filters.....	105	Bottger, Hydrated Sodium Sulphides.....	531
Bell, D. W. See Sweetser.....	608	Bottlinger, Action of Benzyl Chloride on Aromatic	
Bell, J. Densities of Fats.....	66	Hydrocarbons.....	221
Separation of Alumina from Phosphates.....	152	Bouchardat, G., and Lafont, J. Oxidation of Oil of Tur-	
Bell, J. C. Density of Butter.....	66	pentine.....	174
Bellingrodt, F. Extraction of Mercury from Zinc-blende	531	Boudet, Elaidin Test for Olive Oil.....	305
Benardos, N. de, and Olaszewski, S. Use of Voltaic Arc in		Bouillon, E. "Dry Extract" in Wines.....	612
Working Metals.....	675	Bouillet, L. J. B. Ultramarine.....	523
Bender, C. F. Aquinite.....	320	Bouile, L. Saving Hops in Brewing.....	453
Benedikt, See Zsigmondy.....	177	Treatment of Hops.....	515
Benedikt and Zsigmondy. Determination of Glycerine.....	70	Boulton, W. Decoration of Glass.....	100
Benjamin, P. Secondary Batteries.....	106	Bousingault, Iron in Daily Food.....	227
Benkiser, See Nietzki.....	450	Bousingault, Stable Manure.....	511
Bennet, W. G. B. Treatment of Sewage.....	39	Bowers, J. A. Purifying Water.....	158
Bennet, O. W. Carburetter for Air, etc.....	373	Bowkley, W. South Staffordshire Coal.....	414
Bennett, A. R. Voltaic Batteries.....	172	Box, T. Strength of Cast Iron.....	292
Bennett, R., and Peet, H. Composition for Mural Decora-		Braun, T. Tannin.....	672
tion.....	103	Brandstätter, J. Artificial Stone.....	327
Bensemann, R. Estimation of Glycerol in Wine.....	509	Brandt, Burner for Petroleum Residues (illus.).....	474
Bente, T. Treatment of Lupines.....	169	Brenner, W. Treatment of Sewage.....	451
Berensford, Lord C. Rivers Purification Bill.....	158	Brentini, P. Saponaceous Material.....	381
Berges, A. von. Krupp's Pyrometer (illus.).....	23	Brevort, H. L., and Roberts, J. L. Electric Batteries.....	106
Berglund, E. Bromine in Sea Water.....	40	Brin, A. Binoxide of Barium.....	428
Bergstrom, Bessemer Steel.....	607	See Quentin and Brin.....	101
Berger, Manuring Experiments with Phosphates.....	541	Brin, L. Q. and A. Separation of Oxygen and Nitrogen	
Berlin <i>Anhaltische Maschinenbau-Aktion Gesellschaft</i> ,.....		from Air.....	40
Treatment of Ammoniacal Liquors.....	167	Brin, Q. and A. Oxide of Barium.....	31
Berliner, T. Extraction of Fat from Bones.....	672	Brinell, J. A. Change of Texture of Steel.....	538
Bernays, Discussion on Testing Cement.....	199	Brock, J., and Rowell, W. A. Chromates.....	211
Bernbeck, Decomposition of Apomorphine Hydrochloride.....	173	Brock, J., and Saye, E. Conveying and Distributing Acid,	
Bernthsen, A. Action of Heat on Aniline.....	317	etc. (illus.).....	427
Incandescent Lamps.....	511	Brookes, A. G. Acid for Beverages.....	616
Phenazine.....	661	Distillation of Glycerine.....	329
Berrington, A. T. D. Regenerating Waste Gases.....	160	Manufacture of Glycerine.....	431
Berry, E. E. See Sulman.....	177	Metallic Alloys.....	31
Bert, P. Sterilisation of Bacteria.....	262	Brown, Solid Caustic Soda.....	283
Berthelot, Carbon Chloride.....	232	Brown, E. O. Iodide Process of Valuation of Copper Ores.....	49
Fixation of Nitrogen by Soils.....	103	Brown, J. Campbell. Discussion on Cotton-seed Oil.....	205
Berthelot and Vieille. Rate of Explosion of Hydrogen		Address to Liverpool Section.....	565
and Oxygen.....	370	Discussion on Redonda Phosphate.....	572
Influence of Dilution on Explosion of Gases.....	15	Discussion on Wood as a Paper-making Material.....	350
Heat of Combustion.....	159	Saccharine.....	319
Berthelot and Andre. Formation of Oxalic Acid in Plants.....	511	Brown, L. Pigments from Iron Ore.....	35
Berthier, Caloric Value of Fuel.....	581	Brucke, Pepsin.....	451
Berzelius, Etching on Glass.....	669	Bruhns and Volpert, Invert Sugar.....	428
Beurl, J. M. Manufacture of Glass Articles.....	536	Brunjes, F. Carbonate of Potash.....	428
Bevan, See Cross and Bevan.....	239	Brunner, Discussion on Redonda Phosphate.....	571
Bevan, E. J. See Menzies, R. C.....	321, 332	Brunner, Mond and Co. Soda.....	356
Beveridge, J. Commercial Sulphate of Alumina.....	16	Brustlein, M. Chrome Iron.....	605
Beyer, C. Action of Acetone on Aniline.....	238	Bryant, J. H. See Thompson and Bryant.....	100
Bichel, C. E. Explosives.....	457	Buch, See Zega.....	509
Biedermann, A. Hydroxythionaphthen.....	418, 419	Buchner, E., and Curtius, T. Gelatin.....	381
Thiophenol.....	419, 481	Buchner, G. Mercurous Sulphate.....	199
Biel, T. Reaction of Cocaine.....	335	Buckingham, A. Substitute for Leather.....	495
Biel, H., jun. Experiments with "Thomas" Slag.....	212	Budd, J. Imitation Marble, Malachite, etc.....	327
Bigazzi, Invert Sugar.....	517	Buff, Black-ash Vat.....	358
Bindscheller, Green Dye.....	508	Buisite, A. Composition of Wool-grease.....	539
Birch, W. Washing and Dyeing Machine (illus.).....	239	Bunn, P. C. Pigments from Waste Lead Ores.....	432
Birnbaum, Acids in Butter.....	618	Bunsen, Pressure of Explosion.....	12
Bischoff, G. Volumetric Estimation of Chlorine.....	286	Bonte, H. Valuation of Gas-coal.....	653
Bischof, G. Analyses of Fire-Clay.....	459	Burjorji, A. Thermo-electric Batteries.....	615
Bischof, G. Notes on Koch's Water Test (illus.).....	111	Barre, Estimation of Copper.....	51
Bischof, Action of Spongy Iron on Liquors containing		Butler, S. Artificial Fuel.....	317, 373
Arsenic.....	300		
Discussion on Treatment of Sewage.....	318	Cahn, E. L. Methylanthragalol.....	509
Organisms in Water.....	267	Caldewood, Standard of Viscosity.....	131
Black, W. Artificial Fuel.....	256	Calman, A. See Rumberger and Calman.....	26
Blades, F. J. See Dixon.....	168	Calvert and Johnson. Action of Acids on Copper.....	85
Blake, Discussion on Filtration of Water.....	226	Candy, F. Carbonised Materials for Filters.....	675
Blarez, C. Determination of Sulphurous Acid.....	517	Carbonaceous Clay.....	671
Reactions of Sulphoated Magentas.....	178	Canning, Ammonia-soda Process.....	322

	PAGE		PAGE
Cannizzaro, S. Santonin.....	49	Coleman, J. B. Discussion on Filtration of Water	226
Cantani, A. Inhalation of Bacteria	116	Coleman, J. J. Production of Cold	139
Carey, A. E., and Latham, E. Mortar Machine	160	Purification of River Water (illus.)	650
Carnelley, A. Action of Water on Copper	87	Viscosity Tests for Oils (illus.)	339
The Air of Dwellings and Schools	513	Collin, Safranin	319
Carbon Monochloride	232	Collinge, T. Carburetting Air	5
Carnelley, T., and Schleselman, J. Amidodiphenylsulphonic Acid	376	Collins, C., and Co. Antiseptic	451
Caro, S. Solubility of Calcium Carbonate	321	Collins, W. Ship-seathing Metal	85
Carpenter, R. F. Methyl-orange as an Indicator	287	Colson, A., and Gautier, H. Process of Chlorination	321
Solubility of Silver Chromate	286	Coltart, M. G., and Menzies, J. Oils for Batching Wool	323
Carpenter, S. M. Toughened Cast Iron	294	Condy, H. B. Alkaline Sulphates and Hypsulphates	321
Carr, G. W., and Dickinson, J. Composition for Ships' Bottoms	193	Conrad, M., and Guthzeit, M. Action of Dilute Acids on Galactose and Arabinose	36
Carré, Ice Machine	137	Action of Dilute Acids on Dextrose and Levulose	613
Carter, J. W. See Lathrop and Others	217	Decomposition of Milk-sugar by Hydrochloric Acid	672
Casimajor, Filter	510	Cook, W. Scouring Wool	46
Case, W. E. Electric Battery worked by Hent	436	Cooke, G. K. Designs on Coloured Glass	19
Cassell, H. R. Treatment of Metals by Electrolysis	151	Cooper, A. J. Detection of Metals in Water	81
Castelaz, C. Mercury Fumate	218	Cooper, H. J. Portland Cement	100
Castner, H. Y. Alkali Metals	601	Cordner, Allen and Co. Purification of Water	239
Manufacture of Sodium	538	Cornelius, H., and Pechmann, H. von. Synthesis of Orcinol	181
Cattanaach, D. D. Distillation and Concentration of Liquids	40	Cortin, W. T. Stop Valves for Acids, etc.	139
Cnudz, F. Treatment of Sewage	615	Confinable. See Meisel	472
Cavazzi, A. Explosive	516	Cowles, A. H. Electrolytic Treatment of Ores	331
Caventou. Crotonylene Tetrabromide	371	Cowles, E. H. and A. H. Aluminium Furnace (illus.)	206
Cawley, J. Cement	327	Craig, G. Treatment of Slags	152
Cazeneuve, P. Detection of Coal-tar Colours in Wine	178	Crampton, C. A. See Richardson	385
Detection of Acid Magenta	518	Crawford, W. W. Maturing Spirits in Bottles	431
Detection of Magentas	334	Cresson, B. F. Aniline Black	663
Cazeneuve, P., and Lepine. Non-poisonous Colours	230	Cresswell, C. N. Discussion on Treatment of Sewage	318
Cazeneuve and Linossier, G. Detection of Dinitronaphthol in Saffron	437	Creydt, R. Raffinose	386
Chadwick, W. J. Apparatus for raising Beer	211	Crookes. Determination of Phenol	517
Chadlers, H. C. B., and Thorman, A. J. Electrical Batteries	331	Micro-organisms in Water	514
Chamberlain. Rivers Purification Bill	158	Theory of Radiometer	573
Chambors, A. M., and Smith, T. Coke Ovens	375	Crookshank. Organisms in Water	267
Chambers, C. R. See Hughes	615	Cross, C. F. See Menzies, R. C.	321, 322
Champion and Pellett. Examination of Glycerine	177	Cross and Bevan. The Bleaching of Jute	322
Chapce, J. F. Nitrate of Ammonia	325	Oxycellulose	230
Treatment of Vat Liquors	325	Crossley. Estimation of Rosaniline Salts	288
Chantard, P. Detection of Ketones	288	Crowder, W. Discussion on Testing Cement	198
Chapman, J., and Foote, R. Carbonic Acid Generator (illus.)	667	Crowder. Discussion on Estimation of Nitrous Acid	631
Chatelier, H. Le. Dissociation of Calcium Carbonate	183	Crystal, W. J. Chromates	167
Chattaway, W. Examination of Oils	283	Csete, J. Refrigerator for Liquids	158
Cheesebrough, F. J. P. Manufacture of Iron and Steel	212	Cuisinier, L. Addition of Anesthetics to Wort during Saccharification	331
Chem. Fab. Act. Gesell. Hamburg. Treatment of Waste Acids	160	Cullen. Formation of Ice	133
Cherry, C. Blast Furnace	607	Cummings, U. Cement	429
Chevrel. Determination of Glycerine	79	Sulphuric Acid	451
Chiapponi, M. See Huntington, T. C.	523	Curphey. Discussion on Purification of Water	381
Chittenden, T. P. Aerating Liquors and Worts	671	Curtius, T. See Buchner	381
Christie. Discussion on Alginic Acid	221	Curtman. Detection of Cocaine	171
Discussion on Action of Chloride of Sodium on Soap	91	Cuthbertson, J. N. Address to Glasgow Section	590
Christy, T. Doundake	135	Discussion on Alginic Acid	221
Extraction of Essential Oils (illus.)	436	Daccomo, G. Action of Light on Iodoform	172
<i>Eucalyptus Staigeriana</i>	436	Daclaux, E. Rancidity of Butter	512
Indiarubber	432	Dafert, F. W. Syphon (illus.)	111
Pistachios	10	Dafert, W. Self-regulating Filter (illus.)	504
Christy. Purification of Isinglass by Refrigeration	112	Thermo-regulator (illus.)	504
Claimein and Silber. Formation of Pyridine	236	Dahl, G. A. Blue Dyes	662
Clague. Discussion on Magnesium Sulphhydrate	583	Dale. Antimony Mordant	301
Clark. Softening Water	225	Dalzell. See Thorpe	638
Clark, D. K., and Peakes, W. J. E. Filter Presses	411	David. Treatment of Copper Ore	399
Clark, F. W. Gas Manufacture	651	Davies, J. W. Utilisation of Leather Waste	329
Clark, J. W. Dust and Smoke	572	Davies, P. J. Burning Lead Joints	131
Clark, T. Dyed Hosiery	229	Davis, D. Tinplate Manufacture	191
Clark, W. R. See Gilmore, J.	316	Davis, G. E. Discussion on Calorimeter	381
Clarke, E. Strength of Cement	195	Enrichment of Coal Gas by Hydrocarbons	2
Classen. Determination of Manganese	392	Note on Caustic Soda	351
Classen, A., and Ludwig, R. Quantitative Analysis by Electrolysis	331	Yield of Tar	559
Classen and Bauer. Action of Hydrogen Peroxide on Antimony Sulphide	39	Davis, J. Dressing Ores	35
Estimation of Sulphur	331	Davy. Ozone in Atmosphere	650
Claudet. Electrolytic Valuation of Copper	280	Davy, Sir Humphry. Corrosion of Copper by Sea Water	84
Claudet, F. Spanish Pyrites	296	Dawson. Discussion on Corrosion of Copper	89
Claus. Ammonia Process of Gas Purification (illus.)	145	Dawson, W. H. Stiffness of Starch Paste	115
Azophenylene	661	Deacon. Ammonia Soda Process	322
Claus, A., and Mieleke, P. Naphtholsulphonic Acids	378	Testing Cement	197
Claus, A., and Kuyrin, M. Alpha-Naphthol-Beta-Sulphonic Acid	28	Deacon, H. W., Hurter, F., and Elnore, W. Treatment of Sulphides by Electrolysis	99
Claus, A., and Volz, O. Naphtholsulphonic Acid	29	Dean, S. C. See Bailey	421
Claus, C. F. Spreeder for Liquids (illus.)	94	Death, J. Gelatinised Grain for Brewing	104
Clausius. Compression of Gases	139	Degen. Defecation of Beet Juice	612
Clayton, J. and J. Filters	111	Influence of Alkalinity of Beet Juice	612
Cleave, H. See Price	171	De Haen. Estimation of Copper	51
Clegg. Enrichment of Coal Gas	3	Purification of Water	531
Clerget. Rotation of Sugar	286	Deherain. Nitrogen in Soils	104
Clerk, D. Specific Heats of Gases at High Temperatures	11	Delme, A. L. G. Purifying Feed Water	233
Cleve. Naphthylaminesulphonic Acid	376	Delombe, A., and Prouvost, A. Scouring Wool	97
Cline, L. Artificial Fuel	125	Washing Wool	563
Cloez and Guignet. Lokao	162	Beligny, E. Purifying Precipitated Copper	212
Cloze, N. J., Rose, P. R., and Aubery, J. M. Soap	609	Bellet. Percentage of Juice in Sugar Cane	453
Cobley, T. H. Carbon Alum for Sewage	151	Demski. Examination of Oils	491
Purification of Polluted Water	199	Demski, H. See Morawski	179
Codazzi. Calculation of High Temperatures	635	Demster, A. Distillation of Ammoniacal Liquor (illus.)	359
Cohen. Discussion on British Chemical Industries	358	Enriching Coal Gas	421
Cohn, M. E. Treating Vegetable Fibres	221	Demuth, R. A Second Thioxon	489
Coleman. Discussion on Alginic Acid	221	Denniston, P. Composition for Ships' Bottoms	329
Discussion on Antimony Mordants	362	Dennstedt, M., and Zimmermann, J. Transformation of Pyroline into Pyridine	236
Examination of Oils	309	Derekmann, C. Registering Thermometers	316
		Desruelles, A. W. Electric Batteries	455
		Dewar. Filtration of Water	616

	PAGE		PAGE
Dexter, F. G. Relative Value of Tar and Coke for Heating	425	Evans, R. Pickling Metal Plates	491
Dibdin, W. J. Sulphur in Coal Gas	281	Evans and McBryde. White Caustic Soda	351
Dickinson, J. See Carr, G. W.	195	Evershed, F. See Green	633
Dietzsch, C. Cement Furnace	100	Ewer and Pick. Azo-colours	481
Line Kiln	328	Ewing, A. C. Filter for Sugar Liquor	671
Dieudonne, H. Estimation of Tannin	349	Faber, C. See Lathrop and Others	247
Ditmar, Analysis of Chloride of Sulphur	639	<i>Fabrik Chem. Prod. Act. Ges. Berlin.</i> Lanolin	671
Dittmar. Discussion on Utilisation of Carbonic Acid	94	Faguet, E. D. Covering for Boilers, etc.	609
Dyers. Pure Sulphuretted Hydrogen	210	Fahlberg, C. Saccharine (Coal Tar)	75
Dixon, H. R. Action of Carbonic Oxide on Steam	370	Fahlberg, C., and List, A. Compounds of Organic Alkaloids with Saccharine	677
Dixon, H. Combustion of Carbonic Oxide and Hydrogen	370	Fahlberg. See Semper and Fahlberg	20
Dixon, J., Blades, F. J., Douglas, W. S., Garlick, D., and Malcolm, W. Furnaces for Smelting Pyrites	168	Fahnehjelm, O. Incandescence Lamp	424
<i>Dobson Patent Tanning Process Co.</i> Tanning Hides	433	Fajfa. Testing Cement	197
Doehner, O., and Miller, W. v. By-products of Quinaldine	238	Fairbairn. Strength of Cast Iron	289
Hexylamylquinoline	161	Fairley, T. Adulterations in Dyestuffs	286
Doering, F. B. Evaporating Sea-water, etc.	521	Sulphur in Coal Gas (illus.)	283
Douglas, H. Dyed Hosiery	232	Faist. Examination of Oils	303
Don, G., Heekel, E., and Schlagdenhauffen, F. Guttapercha from <i>Russia Parkii</i>	329	Falke, V. Removing Acid in Purification of Mineral Oils	160
Donald, W. J. A. Fire Clay	102	Faraday. Alloy of Aluminium and Iron	209
Donath, E., and Jeller, R. Determination of Iron in presence of Alumina	507	Butylene	571
Donath, J. Dichydromorphine	617	<i>Farbfabrik vorm. Bronner.</i> Azo-Colours	523
Reactions for Morphine	509	<i>Farbenfabrik vorm. F. Bayer and Co.</i> Blue Dyes	661
Dore, J. See Picking	613	Colouring Matters	96
Dorp. See Behr	324	Azo-dyes	427
Dott, G. B. Codicia	332	Fabrysky, S., and Schenk, S. Secondary Batteries	615
Douglas, W. S. See Dixon	168	Farsky, E. Precipitate from Settling-tank in Sugar-refinery	512
Down. Treatment of Cupreous Pyrites	299	Fassbender. Estimation of Phosphoric Acid	176
Dragendorff. Lobelia Alkaloids	501	Faulkner, F., and Wilson, G. R. Treatment of Beer Returns (illus.)	431
Drake, J. A., and Muirhead, R. Filtration of Sewage Filter-presses	115	Faust and Saunne. Trichloronaphthalene	378
Draper, H. N. Colourless Solution of Iodine	332	Favre and Silbermann. Colorimeter	582
Dreschfeld. Detection of Aldehydes	287	Fawcitt, C. A. Chloride of Sulphur as a Vulcaniser	638
Dudley. Durability of Steel Rails	443	Methylic Alcohol	282
Du Roy, C. B. Testing Lubricants	123	Utilisation of Carbonic Acid from Distilleries	92
Dujardin-Beaumetz. Acetophenone	388	Fehling. Examination of Oils	303
Dumas. Nitrogen Determination	388	Fellner, A. Extraction of Cellulose from Wood	106
Supremacy of France in Chemical Arts	413	Fenner. Discussion on Enrichment of Gas	7
Du Motay and Rossi. Ice Machine	159	Kosin Spirit	10
Dun, A., and Hasselacher, F. Galvanic Battery	452	Fenwick, T. Treatment of Waste Tin	515
Duncan. Liquid Soap	162	Feris. Doundakine	173
Dupertuis. See Michler	318	Ferko, M. See Willeroit	100
Dupouche. Therapeutic Application of Alkali Waste	169	Ferpe, A. E. Syrup from Maize, etc.	453
Dupre. Discussion on Treatment of Sewage	348	Fiegl, B. Removal of Oil and Gum by Pepsin	428
Durst, E. See Pfister, J.	492	Fiehl, J. K. Treatment of Hydrocarbons	419
Dussek, A. L. Antiseptic "Sano"	388	Fiehl. See Abel and Fiehl	85
Dyckerhoff. Strength of Cement	193	Fiehsinger, F. Preservation of Timber	670
		Fink, C. Lubricating Compound	329
E. B. Titration of Soda in Presence of Alumina	679	Finkler. Estimation of Mineral Oils in Fats	491
Eastick, J. J. See Lyle, C.	453	Examination of Oils	491
Eckel, H. N. Non-alcoholic Drink	453	The Ekinin Reaction	529
Eckenroth v. Influence of Nitrogenous Manures on Peas	511	Finkler, C. Papaine	359
Eckenroth, H. Salol	677	Furim-Didot. Bleaching	333
Edeisen. Reactions for Resorcinol	580	Fischer, B. Salol	677
Edmunds, J. See Massey-Matthews	105	Fischer, E. Naphthylhydrazines	371
Edwards, G. M. Treatment of Slimes from Ores	328	Fischer, F. Determination of Heat of Combustion (illus.)	159
Egleston, T. Preserving Stone	101	Fischer, O. Kairin	676
Ehrenberg. Bessemer Steel	607	Fischer. Pyrometers	634
Ehrmann. Schweinfurt Green	596	Fischer, E. and O. Nitroloxo Bases	661
Eichbaum, F. Preparation of Soap	495	Fischer and Hufschmidt. Separation of Antimony and Arsenic	534
Eichhorn. See Baeyer	385	Fischer, O., and Gerichten, E. v. Morphine	391
Einhorn. Aldehyde of Quinoline Series	258	Fisher and Phillips. Indicators in Alkalimetry	249
Elbs, K., and Oberg, G. Diparaxylyl Ketone	320	Fitzhagen, J. Manuring Experiments with Phosphates	511
Elbs, R. Aromatic Ketones	321	Fitzpatrick. Discussion on Technical Education	570
Ellasberg, S. Separation of Zinc and Cadmium	41	Flagler, H. K. Commuted Fuel	634
Determination of Bismuth	331	Fleischer. Experiments on Marsh Land with Phosphates	511
Elieson, C. P. Storage Batteries	455	Fleissner, F. See Lippmann	333
Ellin, R. Evaporated Milk	613	Fleming. Substitute for India-rubber	214
Ellis, C. J. Examination of Oils	359	Flemming. Estimation of Glycerine	177
Mauenné's Test for Oils	150	Fletcher. Discussion on Koch's Water Test	121
Ellis, G. H. Filtering Material	105	Fletcher, A. E. Discussion on Testing Cement	198
Elmore, L. Decomposition by Electrolysis	675	Fletcher, E. Treatment of Pig Iron	382
Elmore, W. See Deacon and Others	99	Fletcher, G., and Abell, W. P. Centrifugal Machines	91
Elssesser, E. Azo-dyes	96	Fletcher, T. Bunsen Burners	585
Elsner. See Ambuhl	549	Flückiger and Hesse, O. Quinine Hydrate	501
Emmels, S. H. Galvanic Batteries	455	Focke. Detection of Mineral Oil in Fat Oils	176
Endeman, H. Ammonium Thiosulphate from Gas-producers	470	Foerster, M. v. Explosives	592
Endemann, H. Disinfectant Liquid	105	Folk-Desjardins, C. See Baptiste-Regi	167
Engel, R. Methyl-orange as Indicator	437	Folkard. See Heisch	634
Indicators in Alkalimetry	249	Foord, J., and Paddon, W. W. Carburetter for Air, etc.	322
Solubility of Calcium Carbonate	324	Foot, R. See Chapman, J.	667
Action of Mineral Oils on Metals	362	Ford, A., and Archer, J. A. Covering for Roofs, etc.	671
Indicator for Polybasic and Weak Acids	392	Ford, H. J. T. Composition for Ships' Bottoms	35
Eagler, C. Petroleum Oil of Baku (illus.)	472	Fore, S. See Nolting and Fore	27
Pseudocumene and Mesitylene in Petroleum	25	Forest, A., and Welsh, W. Drying Machines for Blood, etc.	675
Valuation of Petroleum (illus.)	654	Formay. Discussion on Viscometry	132
Engler, C., and Levin, I. Comparison of Petroleum	477	Forquignon. Carbon in Iron and Steel	493
Engler, C., and Richm, P. Action of Acetone on Anilin	288	Forsling, S. Naphthylamine Sulphonic Acid	481
Engling. Lactoglobulin	397	Forth, H. Antimony Mordants for Hosiery	391
Erb, L. See Janovsky	588	Fox, W. Determination of Glycerin	70
Erlenmeyer. Decomposition of Hippuric Acid	261	Fox, W., and Wanklyn, J. A. Determination of Glycerol	516
Flask	392	Franken. Purification of Beet-sugar	612
Eschellmann, G. See Muspratt and Eschellmann	33	Frankenburg, J. Waterproofing Fabrics	321
Eschka. Estimation of Sulphur in Coal	155	Frankland. Dust and Smoke	572
Eschourt, C. Densities of Fats	66	Filtration of Water	616
Eschourt. Discussion on Stiffness of Starch Paste	115	Treatment of Sewage	317
Evans, E. Discussion on Corrosion of Copper	89	Frankland, P. F. Discussion on Treatment of Water	271
Evans, H. S. Obituary	157	Examination of Water	261
		Koch's Water Test	111

	PAGE		PAGE
Frankland, P. F. Discussion on Utilisation of Tar	563	Goutard, A. Gas Scrubber	317
Filtration of Water	117	Grabowski. See Hlasiwetz	29
Fraser, E. J. Treatment of Wines by Electricity	153	Graddon, J., and Harding, P.	471
Fraser, W. M. Stills for Mineral Oils	376	Grache, Action of Heat on Aniline	317
Freeman, J. B. White Pigment	539	Phenanthrene-hydroquinone	419
Freny, Cements	603	Pyrenequinone	595
Fremy, E., and Urbain, V. Treatment of Rhea Fibres	150	Synthesis of Acridine	384
French, A. Manufacture of Chloride of Ammonium and Cyanogen Compounds	33	Graf, H. Metallic Paints	3
Fresenius, Estimation of Copper	51	Grafton, J. Utilisation of Tar	353
Potassium Phosphate as Manure	672	Graham, The Paraffin Industry	162
Fresenius, R. and W. Adulteration of Cement	198	See Japp	483
Freund, M., and Will, W. Alkaloids of <i>Hydrastis Canadensis</i>	677	Grandea, H. Action of Potassium Sulphate on Phosphates	515
Frew, J. Pyrometer	94	Grandval and Valser, Sparteine	189
Friedlander and Henriques, Anthranil	219	Gra t. Portland Cement	509
Fries, Silk Plants	482	Grassi, G. Air Thermometer (illus.)	616
Fries, J. W. Tanning Hides	540	Gutzel, R. Aluminium	608, 616
Friswell, R. J., and Myall, A. Filter Presses	233	Gray, Dyar, and Hemming, Ammonia-soda Process	322
Frobach, C. Extraction of Saccharine Matter	104	Gray, A. R. Washing Ores	431
Fromm, A., Ballo, M., and Kugler, F. T. Heater for Wine, etc.	211	Green, A. G., and Evershed, F. Estimation of Nitrous Acid	633
Frue Tanning Machine Co. Washing Machine for Ores	328	Green, F. A., and Needham, E. Fluid for Cleansing	165
Fruhling, Cements	602	Green, F. A., and Walker, C. M. Regenerative Gas Lamps	595
Fruhling and Schulz, Radinose	386	Grevigke, E. Azo-derivatives of Metaxyleneol	318
Frusher, T. Ink from Waste Dye Liquors	427	Griepentrog, H. Triphenylmethane	482
Fulton, H. B. Arsenic in Spanish Pyrites	296	Griess, Phenylendiamine Derivatives	29
See Watson, E. B.	499	Griffiths, A. B. Use of Ferrous Sulphate in Agriculture	433
Fulton, Discussion on Alginate Acid	221	Griffiths, Action of Iron on Vegetation	511
Pyfe, Discussion on Viscosity Determinations	149	Action of Iron Salts on Vegetation	385
Pyfe, J. See Morton, A.	591	Influence of Iron on Plants	611
		Grimm, W. G. See Sarmiento	435
Gaens, F. Explosives	678	Grimshaw, H. Discussion on British Chemical Industries	353
Gaillet and Huot, Purification of Water	531	Treatment of Waste Galvanised Iron	451
Softening Water	269	Discussion on Chloride of Sulphur	641
Gaillet, Mme. Vve. Dye for Silk, Wool, etc.	553	Grimshaw, W. Treatment of Excreta	216
Galland, G. Colours from Benzidine	322	Grimshaw, Discussion on Chemistry of Fixed Oils	71
Galland, M. G. Chrysamin as a Mordant	582	Discussion on Stiffness of Starch Paste	115
Gamble, Potassium Chlorate	408	Grimus, Ammonia-soda Process	322
Garcia, M. R. Disinfectant	435	Grittner, A., and Szilasi, J. Determination of Rosin in Soap	392
Gardner, E. M. Galvanic Battery	106	Groll, A. Metanitrodimethylamine	319
Gardner, E. V. White Lead	329	Nitration of Dimethylamine	376
Garlick, D. See Dixon	168	Grondahl, V. Determination of Arsenic in Iron	517
Gas Referees, Sulphur Test (illus.)	283	Grosjean, Filter	510
Gash, H. Sulphocyanides	324, 379	Examination of Wine Lees	497
Gaskell, H., jun. Carbonate of Soda	240	Grosvenor, F. Filters	388
Gates, W. L. Galvanic Batteries	515	Groth, L. A. Removing Grease by means of Infusorial Earth	102
Gattermann, L., Kaiser, A., and Meyer, V. Structure of Thiophen	160	Grove, Reduction of Carbonic Acid	370
Gauntlett, W. H. Metallic Thermometers	234	Groves, Discussion on Treatment of Sewage	348
Gantier, F. Silicon in Foundry Iron	603	See Stenhouse	599
Gantier, H. See Colson, A.	321	Grune, F. W. Elastic Leather	452
Gayon, U. See Millardet, A.	496	Gucci, P. Separation of Nickel and Cobalt	618
Gayon. See Millardet	169	Guignot, See Cloez	162
Gedge, W. E. Dyeing Wool	533	Gutard, C. F. Condensation of Smoke and Dust by Electricity	172
Gemmik, W. Phototelegraphy	216	Electric Deposition of Soot	574
Gerhard, F. Sulphuretted Hydrogen Free from Arsenic	40	Gundelach, Black Ash Vat	358
Gerichten, E. v. See Fischer, O.	391	Gurke, O. See Rud Jph. C.	662
Gerlach, G. Specific Gravities	217	Gutensohn, A. Coating Metals with Tin, etc.	452
German Chemists' Union, New Drugs	601	Guthzeit, M. See Conrad and Guthzeit	36
Gershon, Filtration of Water	614	See Conrad	672, 673
Gerson, Filtration of Water (illus.)	117		
Geuns, J. v. Pasteurised Milk	498	Habermann and Honig, Oxidation of Levulose	170
Ghillany, E. Phenolsulphate (Salol)	501	Hadden, J. Separation of Suspended Matter	368
Gibb, Action of Spongy Iron on Liquors containing Arsenic	300	Haddock, A. G. Estimation of Copper	51
Giesel, E. Permanganate as Reagent for Alkaloids	310	Hagenmann, O. C. Purification of Glycerine	432
Giesel, F. Permanganate as Test for Cocaine	335	Hagen, O. Stability of Explosives on Heating (illus.)	436
Gilbert, See Lawes and Gilbert	103	Hager, H. Detection of Arsenic	617
Giles, W. B. Discussion on Strontia	632	Detection of Starch and Sugar in Honey	179
Giles, W. B., and Shearer, A. Phosphoric Acid	669	Detection of Free Sulphuric Acid	617
Gilligan, J. Puddled Iron and Steel	382	Detection of Free Sulphuric Acid in Vinegar	509
Gillitzer, A. See Wagner, L. v.	330	Detection of Turpentine	393
Gillman, A. W., and Spencer, S. Finings for Brewers' Waste	671	Reagent for Benzoic Acid	393
Gilmore, J., and Clark, W. R. Heat Recorder	316	Hydrochloric Acid free from Arsenic	534
Gintl, W. See Nohack and Gintl	241	Liquorice in Beer	508
Giraud, Gas Regulator (illus.)	432	Testing Mineral Oils	616
Gisborne, J. S. Coating for Ships' Bottoms	176	Naphthol as a Test for Nitric Acid	457
Gjers, J. Steel Manufacture	102	Turpentine in Oil of Mint	174
Gladding, Determination of Rosin in Soap	328	Hales, A. J. Preparation of Hides and Skins	212
Glaser, Lanolin	382	Haines, Conessine	501
Glendinning, N. Treatment of Copper Liquors	431	Discussion on Foundry Iron	295
Goedicke, E. Bessemer Steel	607	Haldane, The Air of Dwellings and Schools	543
Goldammer, A. Solubility of Lime in Water	450	Hall, A. T. Extraction of Oil from Waste	452
Goldschmidt, See Hintz	419	Refining Vegetable Oils	452
Goll, O. See Nietzki and Goll	238	Haller, S. Silyc and Pimaric Acids	25
Goodyear, Vulcanised Indiarubber	211	Hallett, B., and Wiley, T. F. Applying Waterproofing Material	239
Goodall, Discussion on Antimony Mordants	302	Hallett, See Wiley	165
Goodwin, C. K. Carbons for Batteries	331	Hammersten, Lactoglobulin	387
Gooden, R. E. Insulating Material	152	Hampe, Estimation of Manganese	219
Gorman, Production of Ice	112	Hamsek, Solubility of Caoutchouc	168
Gorman, W. A. See Varley and Gorman	92	Hamford, Discussion on Antimony Mordants	302
Goslich, W. Fuel used in Breweries	612	Discussion on Filtration of Water	225
Gosling, M. S. Soap Paste	229	Hang, J. J., and Hoffmann, C. Substitute for Indiarubber	212
Gossage, Discussion on Cotton-seed Oil	205	Hanson, P. See Rudell	550
Use of Pyrites Smalls	103	Hanson, J. Disinfection of Sewage	611
Ammonia-soda Process	322	Purifying Coal Gas	95
Gossage, W. Solid Caustic Soda	283	Hansen, A. Brucine	330
Gottig, C. Hydrated Sodium Sulphides	431	Harbord, F. W. Removal of Metalloids in Basic Furnace	605
Gotlieb, Calorimeter	582	Harcourt, A. V. Correction of Volume of Gas	146
		Harding, P. See Graddon	471
		Hardisty, J. Discussion on Filtration of Water	225
		Hardman, J. Carbolic Acid	426

	PAGE		PAGE
Hardy, H. G. Examination of Oils	283	Holzner, Explosives	502
Harpurath, L. Analysis of Sugar Products (illus.)	170, 386	Hönig, Oxidation of Levulose	433
Barris, H. Purification of Coal Gas	322	See Hobermann	170
Barris, H. J. Voltaic Batteries	388	Hönigsmann, M. Storage of Power by Concentration of Spent Soda Lyes (illus.)	158
Harrison, Production of Ice	142	Hood, J. Ammonium Bichromate	487
Substitute for Indian Rubber	214	Hopkins, W. H. See Picking	613
Harrison, J. Vacuum Pump (illus.)	135	Horn, Grinding "Thomas" Slag	212
Hart, P. Caustic Soda	351	Utilisation of Slag	493
Solid Caustic Soda	283	Horce, W. C. See Ormerod, E.	327
Sulphurous Acid	29	Houghton, Use of Wood for Paper-making	273
Hart, W. B. See Smith, Watson	643	Howard, D. Discussion on Koch's Water Test	119
Hartland, W. H. Purification of Water	641, 651	Discussion on Oxidation of Turpentine	10
Hartmann, F., and Schütze, E. Cholesterol	578	Discussion on Treatment of Sewage	348
Hartmann, W. E. A. Treatment of Waste Liquors from Tin-plate Making	242	Discussion on Utilisation of Tar	562
Hassall, W. Cement for Stoneware, etc.	536	Howatson, A. Separating Solid Impurities from Water	368
Hassencamp, H. Blue Colouring Matters	661	Treating Water with Lime	39
Hasslacher, F. See Dun.	615	Howell, H. Carburetter for Air, etc.	522
Batschek, A., and Zega, A. Action of Paratoluidine on Resorcinol	161	Howes, R. C. Filters for Sugar Liquor	330
Hawkins, J. G. Treatment of Gas in Purifiers	426	Howie, J. Filter	246
Hawliczek, J. Ammonia-soda Process	428	Hoyermann, Utilisation of Slag	492
Haycraft, G. Filters	23	Hubl, Iodine absorbed by Fats	68
Hayler, J., Read, H. S., and Percival, H. G. White Lead	539	Iodine Test for Oils	308
Hazlehurst, G. S. Evaporator with Crystal Collector	24	Hucks, W. Machine for Filtering	423
Head, Properties of Cast Iron	289	Huet, See Gaillet	269
Heathfield, R. Waste Products from Galvanising Iron	615	Hufner, Azotometry	505
Heckel, E., and Schlagdenhauffen. African Bark	173	Hufschmidt, See Fischer	331
Roundake	435	Hughes, F. V., and Chambers, C. R. Carbons for Electric Lamps	615
Gutta-percha from Bassia	168	Humphreys, N. H. Discussion on Utilisation of Tar	562
Heckel, E. See Don, G.	329	Hungerbühler, Vermine	173
Heidelberg, T. See Henmann	597	Hunt, B. Estimation of Tannin	81
Heisch and Folkard. Pyrometers (illus.)	634	Hunt, C. Ammonia Process of Gas Purification (illus.)	445
Heldt, Cements	603	Huntington, T. C., and Chiapponi, M. Treatment of Antimonial Ores	523
Hellhof, Explosives	502	Hurter, F. Pyrometers (illus.)	634
Hellriegel, Nitrogen required for Beet	612	See Deacon and Hurter	99
Hembert, F., and Henry. Preparation of Hydrogen	160	Hurter, Methyl Orange as an Indicator	287
Hemilian, See Baeyer	321	Discussion on Technical Education	569
Henderson, Discussion on Estimation of Alumina	154	Discussion on Valuation of Copper	279
Extraction of Copper	403	Discussion on Wood as a Paper-making Material	250
Treatment of Pyrites	296	Husgafvel, C. Malleable Iron	198
Henderson, A. C. Sugar Manufacture	453	Huss, N. Phosphorus Determination	567
Henderson, N. M. Ammonia Still (illus.)	667	Husson, E. See Tribouillet	674
Stills for Shale Oils	376	Hutcheson, Discussion on Action of Chloride of Sodium on Soap	91
Henriques, See Friedländer	319	Hutchinson, C. C. Treatment of Sewage	348
Henry, See Hembert	160	See Johnson, S. H.	423, 653
Herbertz, F. A. Cupola with Steam Blast	451	See Munro	357
Herschhoff, See Nichols	326	Hutchinson, H. Apparatus for Generation of Gas	95
Hervey, R. Alum Manufacture	18	Hutchinson, T. J. Treatment of Greasy Waste	383
Hertz, J. Detection of Alkanet Dye	30	Hutton, J. F. Tanners Purification Bill	138
Diphenylamine for Milk and Wine Analysis	516	Huxley, C. R. Ammoniated Soaps	329
Distinguishing Artificial Colours in Wines	548, 618	Hvass, L. See Alexanderson, N. A.	433
Milk Analysis	619		
Herzfeld, Peat Charcoal in Sugar Refining	612		
Herzfeld, A. See Börnstein	170	Ibbotson, C. Gas from Steam and Coke	3
Herzfeld, A., and Winter, H. Levulose	433	Iblinski, M., and Knorre, G. V. Separation of Iron and Aluminium	41
Hesekiel, A. Beta-Nicotine	95	Imperatori, L. Extraction of Phosphorus from "Ferro-phosphor"	102
Hesse, O. See Flückinger. Quinine	501	Imray, O. Wrought Iron from Ore	491
Pseudomorphine	616	Industrial Society of Mithouse. Report of Meeting	322
Hesse, Morphine	591	Ingram, E. See Almiss	172
Heumann, K., and Heidelberg, T. Influence of Substitution on Shade of Colours	597	Innes, J. Assay of Copper Ores	276
Heusler, F., and Klingner, H. Selenides from the Andes	31	Iyer, A. Separation of Zinc and Cadmium	41
Hewes, J. Treatment of Excreta	387	Iwabuchi, K. Japanese Ultramarine	466
Heyden, F. von. Oxyquinoline Carbonates	616	Iwand, M., and Kahne, F. Treatment of Wool, Rag, etc.	322
Salicylic Acid	501		
Heywood, Discussion on Materials used in Dyeing	75	Jackson, C. L. and Wing, J. F. Action of Sodium on Tri-benzylamine Benzenetrisulphonic Acid	277
Hickisson, J. Marking Ink Pencils	50	Jackson, See Baeyer	161
Hicks, J. J. Thermometers	652	Jacobi, Azotometry	505
Graduated Glass Measures, etc.	652	Jacobsen, O. Action of Sulphuric Acid on Durene	375
Hicromimus, A. Size	672	Pseudocumenesulphonic Acid	375
Higgins, F. H. W. Voltaic Batteries	388	Metaxyleneol	297
Higgin, W. H. Bichromate of Soda	33	Alpha-Amido-m-Tolonic Acid	297
Hilkenstock, G. Basic Slag	606	Isomeric Xylenes	374
Hilker, A. Determination of Thine	178	Paracumenesulphonamide	585
Hill, Priority in Use of Pyrites	402	Jacobsen, O., and Schnapau, E. Durene	25
Hiller, M. See Bohrmann	423	Jagno, Aspirator	504
Hills, F. C. Treatment of Gas Liquor	656	Jahns, E. Alkaloids from Fenugreek Seeds	247
Hilt, Safety of Dynamite in Coal Mines	167	James, S. H. Treatment of Sewage	39
Hinsberg, Naphthyltolquinoxaline	320	Jameson, A. C. See Pryor	326
A Quinoxaline	377	Janovsky, J. V., and Erb, L. Bromo- and Nitro-derivatives of Azo Bodies	598
Reactions for Orthodiketones	419, 580	Japp and Graham. Dipnoline	162
Hintz and Goldschmidt. Pyrenic Acid	419	Jarvis, D. See Schmittborn and Jarvis	241
Hirschsohn, E. Detection of Gamboge	171	Jarvis, G., and Tucker, A. E. Steel Converter Bottoms	338
Reactions of Resins	168	Jean, F. Estimation of Tannin	178
Illasiwetz and Grabowski. Carminic Acid	29	Jeller, R. See Dunath, E.	507
Hocking, See Oxlund	428	Jensch, E. Disintegration of Phosphate Slag by the Air	672
Hodgkinson, Strength of Cast Iron	289	Iron Phosphide in Basic Slag	451
Hoff, H. J. von, jun. Malic Acid	210	Jensen, P. Electrolytic Manufacture of Metals	324
Hoffman, Substitute for Indianrubber	211	Jodlbauer, M. Nitrogen Determination	510
Hoffman, M., and Weinberg, A. Azo-colours	427	Johnson, A. Leather	329
Hoffmann, C. See Hang and Hoffmann	212	Johnson, A. E. South Staffordshire Coal	444
Hoffmann, A. W. Amylaniline	162	Johnson, D. Explosives	678
Hoffmann, Action of Heat on Aniline	347	Johnson, E. Filters	245
Azotometry	505	Johnson, S. H. See Munro	387
Magdala Red	180	Johnson, S. H., and Hutchinson, C. C. Filter Presses and Forcing Liquids by Compressed Air	368
Treatment of Sewage	347	Milk of Lime	423
Hofmayer, J. Waterproof Material	496	Subsidence Apparatus (illus.)	653
Holdelieiss, Phosphorus in Slag	493		
Holgate, G. Preserving Meat	37		
Holladay, T. Azo-colours produced on Fibres	96		
Azo colours on Cotton	606		
Holz, See Staedel and Holz	28, 237		

	PAGE		PAGE
Johnson, Discussion on Treatment of Water	273	Kopp, E. Potassium Antimony Oxalate	165
Discussion on Viscometry	132	Koppenschaar, Determination of Phenol	618
See Calvert and Johnson	85	Triphenylphenylbromide	547
Johnstone, A. S. See Wiegman	172	Korner, Reactions for Orthodiketones	580
Jolles, A. Washing and Drying Precipitates out of Contact with Carbonic Acid (illus.)	507	Korting Bros. Spray Apparatus for Tar (illus.)	471
Joly, A. Titration of Phosphoric Acid	391	Kosmann, Thallium in Zinc	193
Titration of Phosphoric and Arsenic Acids	510	Kostanecki, H. v. Synthesis of Beta-Orcinol	499
Jones, E. W. T. South Staffordshire Coal	414	Kostanecki, S. v. and Nieniewowski, S. Dihydroxydimethylanthraquinone	25
Jones, H. E. Discussion on Utilisation of Tar	562	Kottstofer, Examination of Oils	194
Jones, T. J. Voltaic Batteries	500	Kraut, E. Behaviour of Zinc containing Lead	537
See Tasker	172	Kremel, A. The Discolouration of Carboic Acid	160
Jones, T. J. and Tasker, W. H. Plates for Batteries	500	Kretschmar, Estimation of Iron and Aluminium in Superphosphates	176
Jones, W. R. Firing with Tar and Breze	125	Krensler, U. Correction of Volume of Gas	116
Jorissen, Detection of Free Sulphuric Acid	509	Krey, Arsenical Sulphuric Acid for Treatment of Mineral Oils	671
Joule, J. P. Calorimeter	582	Krieger, Iodoformium Aromatisatum	248
Joule, Compression of Gases	139	Krupp, Pyrometer (illus.)	23
Joulie, Nitrogen on Soils	104	Kugler, F. T. See Fromm, A.	241
Joy, A. B. and Lewes, J. J. Imitation Marble	100	Kühne, F. See Iwand	322
Joy, W. Cement	327, 381, 536	Kulmann, W. Estimation of Phosphorus in Pig Iron	176
Julien, E. Secondary Batteries	451	Kunath, The Thickening of Coal Tar	160
Julin, Carbon Monochloride	232	Kunz, H. Atropa Belladonna	219, 456
Julius, P. Congo Red as an Indicator	679	Kutscheira, E. and Utz, A. Alumina Mordants on Cotton	531
Magdala Red	180	Influence of Steaming on Colours	632
Junker, Alteration of Oil in Petroleum Lamps	372	Kynaston, J. W. Alum	17
Jupner, H. v. Analysis of Cyanogen Products	334	Sulphite and Bisulphite of Lime	31
Jurgens, A. Alkaloids of Aconitum Napellus	174	Sulphur from Sulphuretted Hydrogen	99
Jurisch, Caustic Soda	210	Kynaston and Rideal, Estimation of Nitrous Acid	631
Justice, P. M. Waterproofing Leather	36		
		Ladenburg, A. Hepeine	171, 248
Kahlbaum, Dissociation	183	Picoline	236
Kahn, M. Condensation of Butaldehyde with Aniline	161	Piperidine from Pentamethylenediamine	106
Kaiser, A. See Gattermann	160	Lafferty, H. W. Brewery Refuse as Cattle Food	512
Kalman, W. Standardising Iodine Solutions	391	Laffont, Digitalin	501
Kander, Mononitroanisole	160	Lafont, J. See Bouchardat	174
Kassner, G. German Indianrubber Plants	182	Lajoux, H. Milk	613
Kassner, G. Utilisation of Plants	195	Lake, H. H. Bleaching Oil	609
Kayser, A., Yeung, A. B., and Williams, J. Carbonate of Soda	613	Recovery of Tin from Scrap	193
Kayser, R. Lokas or Chinese Green	102	Refining Sugar	453
Kaysner, R. Antimony Mordant	301	Lake, W. H. Electrical Accumulators	246
Keates, W. T. Sulphur in Coal Gas	284	Treatment of Cocoons	322
Keeling, F. Finings for Beer, etc.	613	Lamm, C. Bellit (an Explosive)	457
Keir, Copper Sheathing for Ships	85	Lamy, Solubility of Lime	450
Kelbe, W. Cymene in Rosin Spirit	595	Landolt, Employment of Saccharine	612
Recovery of Hydrocarbons from Aromatic Sulpho-Acids	317	Landsberg, L. Manufacture of Vanillin	456
Keller, W. Cement Manufacture	101	Vanillin	676
Kellner, O. Action of Iron Salts on Vegetation	385	Lane, J. See Balfour, J. L.	522
Action of Iron on Vegetation	511	Lang, J. Action of Hydrochloric Acid on Antimony Sulphide	30
Oxidation of Sulphur in Peas	385	Langbein, G. Purification of Sewage	216
Kendall, E. D. Solid Battery Excitant	676	Lange, M. Azo-colours	481
Kendall, J. A. Cells for Gas Batteries	675	Lange, O. Alpha and Gamma-Picolines	236
Kenyon, H. Distillation of Coal, etc.	318	Langen, E. Purifying Semi-liquid Substances (illus.)	233
Kertész, A. Antimony Hydrate as Mordant	165	Langmann, F. Consumption of Acid in Discharging Indigo	182
Antimony Oxalate	239	Lantini, M. Y. Determination of Phosphorus	106
Kesterton, H. Metallic Alloys	434	La Rouvière, Silk Plants	482
Khozinsky, A. Electrode Frames for Secondary Batteries	331	Latham, B. Water Supply	225
Kidd, J. H. Treatment of Sewage	615	Latham, E. See Carey and Latham	109
Killick, E. W. Cement	536	Lathrop, F. L. O., Carter, J. W., and Faber, C. Galvanic Batteries	217
Kingsford, C. Cement Manufacture	451	Lauber, Antimony Oxalate	239
Kingzett, C. T. Discussion on Strontia	633	Lauber and Schwieckert, L. Antimony Hydrate and Oxalate as Mordants	165
Oxidation of Turpentine	7	Antimony Mordants	97
Sanitary or Disinfecting Soaps, etc.	102	Laubheimer, J. Estimation of Phosphoric Acid	176
Treatment of Sewage	499	Laurie, A. P. Filter	169
Kingzett, Sterilisation of Bacteria	262	Lawes and Gilbert, Nitrogen in Rain Water	103
Kinnicutt and Nef, Estimation of Nitrous Acid	634	Lawrence, W. Brewing	214
Kirby, J. Carbons for Batteries	515	Lawson, T. A. Reactions of Diazo-compounds	26
Kitchingman, E. L. and Andrews, A. Composition for Ships' Bottoms	495	Leach, W. Sulphur in Coal Gas	286
Kjeldahl, Nitrogen Determination (illus.)	179, 506, 550, 540, 617	Leane, G. H. Purification of Sewage	246
Klannig, O. Apparatus for Drying	398	Use of Carbon with Sewage Sludge	675
Klein, J. Determination of Phosphoric Acid in Slag	392, 502	Leechard, G. Danger of Fire through Nitric Acid	379
Phosphide in Basic Slag	451	Influence of Magnesia in Cement	492
Determination of Phosphoric Acid in Slag	502	Lodebur, A. State of Carbon in Iron and Steel	493
Klein, Examination of Wine Lees	497	Estimation of Manganese	123
Organisms in Water	267	Ledner and Paal, Action of Ammonia on Double Ketones	189
Klinger, H. See Hensler and Klinger	31	Leeds, A. R. Purification of Water (illus.)	38
Klobukow, N. v. Universal Stand for Electrolysis (illus.)	499	Le Franc, L. Extraction of Sugar	330
Knaapp, F. Ultramarine	238	Lehmann, See Pfeiffer	180, 550
Knauss, Examination of Oils	303	Lehmann, G. W., and Mager, W. Estimation of Arsenic	510
Knecht, Chrysamin as a Mordant	532	Lehmann, T., and Petri, J. Liebermann's Colouring Matter	238
Estimation of Rosaniline Salts	288	Lehofer, C. Treatment of Excreta	39
Kniecherbocker Co. Michigan. Separation of Dust from Air	504	Long, J. S. Gas Manufacture	651
Knight, E. M. Filters	22	Leugler, B. White Lubricator for Machinery	329
Knop, W. Azotometer (illus.)	505	Lenz, Burner for Petroleum Residues (illus.)	471
Knorr, L. Ammonia as a Reagent for Double Ketones	180	Lenz, W. Colour Reactions of Alkaloids	137
Knorre, G. v. See Hinski and Knorre	11	Leonhardt, A., and Co. Nitrochrysoindines (Azophosphines)	523
Knyrim, M. See Claus and Knyrim	28	Antifebrin	580
Kobrich, A. Determination of Nickel	503	Lepman, Septonizer	125
Koch, Bacteria in Water	234	Lepine, See Cazeneuve, P.	230
Examination of Water	261	Leslie, Formation of Ice	133
Water Test (illus.)	111	Letheby, Naphtha for Carburetting	4
Koechlin, S. C. Schweinfurt Green	595	Sulphur in Coal Gas (illus.)	284
Koehler, F. W., and Zwierzina, E. Coating Metals with Zinc	152	Leuker, C. Identification of Narcotic Extracts	35
Köhler, H. Glycerine Solution of Antimony	165	Levetus, H. See Lowe and Levetus	26
Kohn, C. A. Kairin	676	Levi, L. Benzylhydroxanthranol	477, 480
Kolbe, C. and Bentsch, C. Naphtholcarboxylic Acid	182	Levin, I. See Engler, C.	351
Koll, G. Iodine Test for Peppermint Oil	179	Levinstein, L. British Chemical Industries	36
Kollen-Corneille, C. Tanning	609	Charging Beer with Carbonic Acid	577
König, Pepton	617	Chemical Substances Recently Introduced	577
Kopfer, Combustion Furnace (illus.)	333		
Kopp, Examination of Oils	305		

	PAGE		PAGE
Levinstein, I. Colours Forbidden by German Government	229	Lyte, F. M. Purification of Sewage	215, 216
Discussion on Materials used in Dyeing	71	Lyte, M. Viscosity of Oils	129
Manchester Jubilee Exhibition	637		
Position of English Industry	143		
Saccharin	75, 369		
Lewer, L. C. The Hardening of Cements	192	Maben, J. Examination of Fixed Oils	282
Lewis, J. T. See Joy and Lewis	200	Macadam, S. Action of Paraffin Oils on Metals	362
Lewis, J. T. Utilisation of Residues in Gas Works	126	McCandless, E. V. Estimation of Copper	302
Lewthwaite, J. Malleable Castings	607	McClave, E. W. Distillation of Turpentine	318
Lewy, L. The Tolidine	181	McCulloch, J. Treatment of Iron Ore	328
Levinann, H. See Will and Leymann	267	McDonnell, A. Treatment of Juice in Sugar Cane	433
L'Hôte, L. Properties of Zinc	69	Macfarlane, J. See Maudsley	676
Lindet, J. E. Galvanic Batteries	541	MacIvor, W. Testing Lubricants	536
Liebermann, A. Colouring Matter	238	McKerlie, J. Milk Purifier	124
Temperature of Oil in Petroleum Lamps	372	Mackinnon, Disc. on Enrichment of Gas	37
Liebermann, C. Azo-opicnic Acid	349	Mackintosh, J. B. Determination of Phosphorus in Iron	107
Cocorin from Living Cockle	319	Estimation of Copper	54
Liebermann, L. Preservation of Milk, etc.	613	Macnab, W. Separation of Suspended Matter	368
Liebermann, A. and Studer. Detection of Rosaniline Salts	287	Macnab, W., and Beckett, G. H. Treatment of Water for Technical Purposes (illus.)	267
Liebrecht, A. Reduction of Nicotine	10	McNaught, Testing Machine for Oils	125
Liebrecht, Ch. ester	579	Viscosity of Oils	339
Liechti, L. Mordanting Cotton	531	McNaught, J. and W. Scouring Machine	600
Liechti, L., and Schwitter, H. Mordanting Wool	523	Macrom, V. Varnish and Paint	303
Liechti, L., and Suida, W. Iron and Chromium Alizates	152	Maetear, J. Chlorides and Hydrates of Barium and Strontium	430
Action of Sulphuric Acid on Oleic Acid	663	Discussion on Strontia	632
Turkey-red Oil	237	Discussion on Utilisation of Tar	563
Liechti, See Suida and Liechti	231	Discussion on Viscometry	132
Liedbeck, A. Distilling Apparatus (illus.)	133	Incandescent Gas-burners	448
Lightfoot, J. B. Ice-making Machinery (illus.)	151	Madsen, H. P. Urilisation of Blood	675
Lillenthal, G. Artificial Stone	292	Mager, W. See Lehmann	510
Lillie. Toughened Cast Iron	424	Maggis, F. R. Preparation of Leather	496
Linde, C. Manufacture of Ice	424	Magnen, P. A. Filtration and Water Softening (illus.)	223
Lindsay, T. S. Gas Producer	334	Softening Water	388
Link, Bacteria in Water	28	Main, W. C. See Swete, O. R.	500
Linke. Naphtholsulphonic Acid	503	Magdicie. Testing Dynamite (illus.)	137
Linnemann, Aspirator	374	Makin, J. Lining for Paper Pulp Boilers	435
Test for Propionic Acid	437	Malcolm, W. See Dixon	168
Linosier, G. See Cazeneuve	101	Mallet, R. Iron for Artillery	293
Lippmann, E. von. Raffinose in Beet Sugar	213	Mallet, Separation of Oxygen from the Air	651
Lippmann, E. O. v. Coniferin and Vanillin in Asparagus	169	Maltzan, F. v. Application of the "Thomas" Slag	385
Source of Melitose in Sugar	333	Value of "Thomas" Slag as Manure	101, 330
Lippmann, E., and Fleissner, F. Combustion Method (illus.)	386	Manbre, A. Temperance Beer	404
Lippmann and Tollens. Raffinose	21	Manby, E. B. See Ainsworth, R. H.	664
Lipscombe, F. R. Filters	677	S. B. See Ainsworth	600
List, A. See Fahlberg, C.	650	Mancion, G. Preserving Timber	431
Lister. Putrefaction of Milk, etc.	21	Mangin, A. H. Unbaling Hides	609
Little, W. G. Carburetting Gas	102	Manhes. Treatment of Copper Ore	390
See Morris and Little	494	Manshield, E. Oil Gas	522
Livache, A. Oxidation of Oils	562	Maquay, S. W. Voltaic Battery	331
Livesey, F. Discussion on Utilisation of Tar	176	Maquenne. Methyl Alcohol in Plants	317
Ljutyk. Oils from Petroleum Residues	210	Marck, G. Germination of Beet-root Seeds	213
Lloyd, Malle Acid	218	Marchand, C. Treatment of Butter	613
Lloyd and Lloyd, C. G. North American Aconite	65	Lactobutyrometer	498
Lloyd-Whiteley, R. Discussion on Filtration of Water	572	Mareker. Nitrogen Determination	180
Lodge, O. Collection of Metallic Fume	455	Marcus. Boudakine	473
Electrical Deposition of Dust (illus.)	169	Marchal. Etching on Glass	669
Loeb, L. N. Galvanic Batteries	213	Marchal, J., and Bories, L. Treating Tannic Extracts	384
Loges, G. Nitrogen in Soils	200	Margets, W. G. Portland Cement	34
Loiseau. Raffinose	421	Margnac and Lunge. Sulphuric Acid	356
Longmore, J. Cotton-seed Oil	322	Markgraf. Explosives	502
Loomis, B. Gas Producer	388	Markownikoff and Oglobine. Russian Petroleum	371
Loradoux, E. Ammonia-soda Process	615	Marquardt, L. Thickening Material for Oils	539
Lorrain, J. G. Chemical Precipitation	105	Marriott, W. and H. Increasing Viscosity of Oils	608
Electrolysis of Compound Bodies	502	Marvin. Baku Petroleum	472
Filtrating Material	21	Martins, C. A. Azo-colours	482
Lösekann, G., and Meyer, Th. Determination of Zinc	619	Martyn, W. Statistics of Pyrites	97
Love, G. Condenser for Coal Gas	3	Mason, W. P. Testing Lubricants	125
Lowton, L. Distinguishing Nickel Plating	35	Massey-Mainwaring, W. F. B., and Edmunds. Oxygenated Water	653
Lowe. Naphthalising Gas	79	Purification of Sewage	165
Lowe, G., and Levett, H. Alloy for Mercurial Gilding	152	Mather. Bleaching	353
Lowenthal. Estimation of Tannin	680	Machine for Bleaching	661
Lublinski, D. Protecting Varnish for Wood, etc.	219	Mathey, H. Cement	328, 536, 603
Lucion, R. Automatic Washing Apparatus (illus.)	54	Mathew, W. de V. See Salamon, A. G.	261
Determination of Iron and Alumina in Phosphates	334	Mathiesen, F. O. Filters for Sugar Liquor	330
Lockow. Estimation of Copper	545	Purification of Sugar	104
Ludwig, R. See Classen	326	Matthew, J. Glazed Surface on Stone	381
Logo, O. Galvanic Batteries	662	Maudsley, P. J., and Macfarlane, T. Sulphur from Alkali Waste	536
Luhmann, E., and Rommenholler, C. G. Measurer for Liquid Carbonic Acid (illus.)	452	Maunenc, E. Test for Oils	150, 361
Lukianoff, P. Turkey red Dyeing	547	Examination of Oils	303
Lukjanow. Action of Sulphuric Acid on Oleic Acid	677	Mawson and Swan. Hide Powder	81
Lundin. Determination of Arsenic in Iron	219	Maxim, H. S. Explosives	678
Lunge, G. Analysis of Explosives (illus.)	283	Maxwell, W. Incandescent Lamps	615
Indicators in Alkalimetry	82	Mayer, A. Use of Gypsum with Liquid Manure	611
Solid Caustic Soda	391	Mehu, C. Solubility of Mercurous Iodide	218
Use of Nitrometer	654	Meincke, C. Estimation of Manganese	219
Valuation of Chloride of Lime	256	Manganese Determination	508
Valuation of Petroleum	468	Phosphorus Determination	509
See Margnac	210	Meisel. Acids in Butter	618
Lunge, G., and Rohrmann, L. Absorption of Gases	505	Meister, Lucius and Bruning. Vanillin	217
Lunge, G., and Schmid, J. Action of Lime on Carbonate of Soda	505	Meisel and Coullinhal. Gasholder (illus.)	472
Lunge, G., and Schmidt, R. E. Analysis of Hot Spring of Leuk	101	Meldola. Beta-Naphthylamine Compounds	29
Application of Nitrometer (illus.)	95	Melvin, J. B. Resinous Compounds	432
Luther, W. H. Baths for Galvanising	453	Mendeleeff, D. J. Earth Oil of Baku	661
Lux, F. Specific Gravity Apparatus	5	Menke. See Wright	423
Lyle, C., and Eastick, J. J. Substitute for Honey	538	Menzies, J. See Collart	383
Lyon, W. Carburetting Gas	39	Menzies, R. C., Cross, C. F., and Bevan, E. J. Paper Pulp	321, 332
Lyte, F. M. Crucibles, etc.	538	Merck, W. Synthesis of Cocaine	10
Causes	538	Merck. Digitoxin	501
Purifying Sewage	39	Papaine	390

	PAGE		PAGE
Merriam, L. P. Battery Cells	172	Mumford, Discussion on Testing Cement	198
Merritt, H. W. Cement	100	Mumford, T. W. B. and Moodie, R. Separation of Sub-	
Merz, Phenazine	651	stances of Different Sizes or Specific Gravities	94
See Weith	178	Munro, J. M. H. Basic Cinder as a Manure	433
Merz and Weith. Thioparaloidine	46	Basic Slag as Manure	161
Merz, V., and Ritz, C. Nitranilines from Nitrophenols	450	Influence of Iron on Plants	610
Messel, Piérot's Liquid	113	Manurial Value of Basic Cinder	610
Metcalf, Alum	18	Munro, J. H. M., Johnson, S. H., and Hutchinson, C. C.	
Mewburn, J. C. Treatment of Yarn, etc.	322	Treatment of Sewage	287
Meyer, Action of Carbonic Acid on "Thomas" Slag	351	Munro, J. H. M., and Wrightson, T. Basic Cinder as	
Meyer, E. V. Commercial Phenyl-hydrazine	27	Manure	101
Meyer, F. M. Cement Furnace	605	Utilisation of Basic Cinder	611
Meyer, T. Zinc from Burnt Pyrites	101	Muntz, A. Galactose in Plants	356
Meyer, Th. See Lösekann	502	Treatment of Mildew	169
Meyer, V. Drying Oven for Laboratories	106	Muntz, F. Discussion on Corrosion of Copper	89
Drying Apparatus	351	Muntz, G. F. Ship-sheathing Metal	85
Thionaphtben	118	Muntz and Ramsbacher. Estimation of Tannin	81
Vapour Density Determination (illus.)	510	Munzer. See Richter	26
See Gattermann	160	Murakawa. Japanese White Lead	312
Meyer and Stadler. Nitrothienol	119	Murrie. Thermometers	635
Meyn, R. A., and Armack, J. F. O. Artificial Stone	603	Murrie, J. Separation of Vapours from Liquids (illus.)	468
Michel, A. Treatment of Fats	432	Musket, R. Ship-sheathing Metal	85
Michel, E. Cements	602	Muspratt, E. K. Address at Fifth Annual Meeting	401
The Hardening of Cement	492	Discussion on Cotton-seed Oil	205
Michler and Dupertius. Tetramethyldiamidobenzopho-		Discussion on Technical Education	569
none	318	Discussion on Valuation of Copper	280
Mielcke, P. See Claus, A.	378	Use of Centrifugal Machines	65
Millardet and Gayon. Action of Sulphate of Copper on		Muspratt, E. K., and Eschellmann, G. Magnesium Chlo-	
Mildew and on Vines	160	ride	33
Presence of Copper in Vines	496	Muspratt, J. Obituary	314
Miller, A. K. See Armstrong	374	Muter. Estimation of Glycerine	177
Miller, A. B. Standard Tartar Ematic Solutions	164	Myall, A. See Friiswell and Myall	233
Miller, J. B. Etching on Glass	620	Mylius, E. Decomposition of Apomorphine Hydrochloride	173
Miller, W. v. Alpha-Phenylquinoline	161		
See Doeberner and Miller	238	Nafziger, F. Sulphocyanides	321
Mills, E. J. Action of Potash on Resins	221	Nagai. Peonol	456
Bromine Absorbed by Fats	68	Nagayo. White Lead as a Cosmetic	312
Candles Prepared to Prevent "Guttering"	652	Nahsen, M. Purification of Sewage	215
Discussion on Action of Chloride of Sodium on Soap	91	Nakamura, J. Estimation of Sulphur in Coal	155
Discussion on Antimony Chloride	593	Napier, J. Viscosity of Oils (illus.)	300
Discussion on Maumene's Test for Oils	112	Native Guano Co. Treatment of Sewage	614
Discussion on Purification of Water	651	Naumann and Pistor. Action of Steam on Carbonic Oxide	370
Discussion on Specific Heats of Gases	15	Decomposition of Carbon Monoxide	607
Discussion on Utilisation of Carbonic Acid	94	Reactions of Carbonic Oxide and Carbonic Acid with	
Discussion on Estimation of Alumina	151	Hydrogen	24
Examination of Fixed Oils	282	Navier. Strength of Cast Iron	289
Examination of Oils	550, 562	Needham, E. See Green	165
Viscosity Determinations (illus.)	118	Nef, See Kinnicutt	634
Minnis, T., and Ingram, E. Galvanising Baths	172	Nef, J. U. Derivatives of Durene	25
Mohlan, R. Action of Hydrochloric Acid on Nitrosodi-		Neilson, A., and Snodgrass, J. Obtaining Ammonia	237
methylaniline	557	Nencki. Salol	577
Benzidine Azo-colours	597	Nesbitt, A. Non-poisonous Colours	229
Indophenols and Indoanilines	28	Nessler. Use of Gypsum with Manure	611
Mohr, C. Ammonium Magnesium Phosphate	502	Neuffer, K. H. Use of Phosphoric Acid with Manure	
Molisch, H. Distinguishing Animal from Vegetable Fibre	608	Liquors	672
Molisch. Reagent for Vegetable Fibre	612	Neville and Winther. Naphthylamine Sulphonic Acid	161
Moller, K. Removing Germs from Liquids	39	Newhall, F. S. Treatment of Alkali Waste	167
Mond, L. Ammonia and Tar from Gases	235	Newhall, G. M., and Tucker, J. H. Treatment of Sugar	330
Mond. Ammonia-soda Process	222	Newlands, B. E. R. Alum	17
Monro. Treatment of Sewage	318	Discussion on Koch's Water Test	121
Montgelas, Count R. de. Aluminium	608	Discussion on Strontia	632
Aluminium	616	Discussion on Treatment of Water	572
Chlorine Manufacture	602	Newton, C. M. Galvanic Batteries	106
Montgomery, W. Fire-proof Cement	781	Neyraud, J. B. Electric Batteries	388
Moodie, R. See Mumford and Moodie	91	Nixson, W. Ripley. Obituary	519
Moon, E. J. Viscosity of Oils	127	Nichols and Herreshoff. Sulphuric Acid Tower	326
Moore, R. W. Examination of Oils	309	Nicolle. See Mort and Nicolle	120
Iodine Test for Oils	282	Niementowski, S. See Kostanekski	25
Morawski, T. Examination of Oils	191	Nin-burger. Precipitated Phosphate	541
Estimation of Glycerine	177	Nietzki. Amidazoxylylene	27
Morawski, T., and Demski, H. Examination of Oils con-		Oxidation of Paradiamines	508
taining Unsataponifiable Fats	179	Xylylene	28
Morewood, E. Tinning Iron Plate, etc.	241	See Wallach, O.	181
Morgan, C. H. Separation of Dust from Air	241	Nietzki and Benkiser. Alpha-Nitraniline	450
Moritz, J. Influence of Processes on Wine	546	Nietzki, R., and Goll, O. Azonaphthalene	238
Morris, R., and Little, W. G. Sheep-wash	162	Nische. Examination of Oils	191
Morris, R., and Wood, J. Grinding Macine for Quartz	158	Noah, E. Xanthopurpurin and Purpurin	319
Mort and Nicolle. Ice Machine	139	Noback, G., and Gunt, W. Treatment of Spent Hops, etc.	241
Morton, A., and Fyfe, J. Distillation of Mineral Oils	391	Nobel, A. Treatment of Explosives	678
Morton, F. G., and Salamon, N. Pulp for Paper	676	Nolling, E. Nitration of Dimethylaniline	376
Moschini, L. Action of Light on Olive Oil	312	Paraxyloquinoline	230
Moseley, C. Battery Cells	172	Pb-halic Acids	27
Moseley, C., and Parker, T. Secondary Batteries	500	Safanine	319
Moss. Salol	577	Use of Oxalate of Antimony	74
Mosso, H. See Arducco	121	Nolling and Collin. Nitration of Dimethylaniline	319
Moszeick, O. Influence of Heat on Absorbent Power of		Nolling, E., and Forel, S. Amidazoxylylenes	27
Animal Charcoal	496	Nordenfellt, T. Blood Albumen	378
Mott, J. L. Lubricating Compound	609	Norton, L. M., and Andrews, C. W. Action of Heat on	
Muck, P. Condition of Sulphur in Coal	521	Paraffins	373
Muencke, R. Heat Regulator (illus.)	519	Notz, J. F. Rendering Substances Non-inflammable and	
Muirhead, A., and Wright, C. R. A. Insulating Com-		able to Resist Putrefaction	96
pound	455	Nowell, S. F. Lactic Ferment	677
Muirhead, A. Cells with Mercury Electrodes	500	Oakes, J. F. Evaporating Apparatus (illus.)	316
Muirhead, R. See Drake, J. A.	115	Öberg, O. F. Freezing Water from Germs	39
Müller, A. Purification of Waste Waters	542	Obermaier, J. O. Treatment of Fibres	239
See Wagner and Müller	39	Odling. Micro-organisms in Water	511
Müller, K. Hexachlorobenzene	212	Treatment of Sewage	319
Müller, J. G. Imitation Majolica Ware	34	Ogata, M. Influence of Drinks, etc., on Digestion	214
Müller-Erbzbaeh, W. Oxidation of Hydrogen	241	Oglobine. See Markownikoff	374
Müller-Jacobs. Action of Sulphuric Acid on Oleic Acid	452	Oberg, G. See Fibbs, K.	320
Turkey-red Oil	665	Oldham, W. Filters (illus.)	368
Müller-Thurgau, H. Starch and Sugar in Tobacco	169	Olzewski, S. See Benardos	675
Influence of Yeast on Wine	387		

	PAGE		PAGE
O'Neill, C. Treatment of Cotton Waste	571	Pitkin, J. Secondary Batteries	100
Ordineau, C. Brandy	512	Pitt, S. Treatment of Auriferous Ore	191
Ordway, J. M. Testing Lubricants	113	Playfair, L. The Paraffin Industry	358
Ormerod, E., and Horne, W. C. Luminous Cement	327	Pochin, H. D. Sulphate of Alumina	17
Osenbrück, A. Ammonia Gas for Engines, etc.	235	Poisueille, Viscosimeter	148
Osmund, Carbon in Iron and Steel	192	Pointon, J. Anti-fouling Composition	510
See Witz, G.	516	Pole, W. Strength of Cast Iron	289
Ossipow, J. Acids in Commercial Lupulin	515	Polenske, E. Cocaine	171
Ostberg, "Mitis" Castings	209	Pollak, K., and Wehr, G. Galvanic Battery	455
O'Sullivan, C. Sugars of Some of the Cereals	36	Polstorff, K. Conesino	501
Otto, R. Purification of Hydrochloric Acid	602	Polstorff, Delydromorphine	618
Removal of Arsenic from Hydrochloric Acid	531	Pseudomorphine	616
Owen, T. D. Treatment of Vat Liquor	32	Pommeraye, L. Filters	468
Oxland, R., and C. Calciner	428	Pontifex and Wood. Ice Machine (illus.)	157
Treatment of Ores	337	Ponton, A. C. Artificial Stone	584
Oxland and Hocking. Calciner	428	Porter and Dixon. Purification of Water	531
		Portmann, G. Detection of Small Quantities of Hydrocyanic Acid	629
Paal. Action of Ammonia on Double Ketones	180	Potter. Discussion on Materials used in Dyeing	75
Thiolenol	419	Potts, C. and A. Clay Mill	100
Paddon, W. W. See Foord, J.	522	Poutet. Adolteration of Olive Oil	301
Pallard, C. A. Metallic Alloys	432	Powell, L. S. See Wynne	172
Pampe, F. Formation of Bad Crude Spirit	330	Powell, L. S., and Selson, R. P. Incandescent Lamps	541
Park, R., and J. E. Soap	671	Pratt, J. W. Decolouring Nitric Acid	31
Parker, T. See Moseley, C.	500	Precht, H. Carbonate of Potash	33
Parker, T. D. C. See Rees, J. P.	675	See Rotger and Precht	40
Parkes, J. Carburettor for Gas	373	Price and Nicholson. Cast Iron	293
Enriching Gas	236	Price, C., and Cleave, H. Treatment of Sewage	171
Parkes. Vulcanised India-rubber	211, 638	Price, H. Commercial India-rubber	211
Parnell. Potassium Chlorate	408	Pridham, C. W. See Upward and Pridham	247
Parnell, E. B. Treatment of Pyritous Ore	382	See Upward, A. R.	351
Parnell and Simpson. Caustic Soda	210	Pringle, W. Discussion on Alum Manufacture	22
Manufacture of Soda	412	Price, Azo-opianic Acid	319
Carbonate of Soda and Carbonic Acid	668	Procter, H. R. Estimation of Tannin	79, 210
Sulphuretted Hydrogen from Sulphide of Ammonium	33	Proctor, T. B. Removal of Tannin from Wine	210
Pasteur. Malic Acid	240	Prouvost, A. See Deletombe and Prouvost	97
Putrefaction	650	See Deletombe, A.	533
Paterson, R. See Alexander and Paterson	160	Prudhomme. Derivatives of Beta-Amido-Alizarin	596
Paton, J. McC. C. Evaporator for Sugar Liquor	330	Pryor, M. R., and Jameson, A. C. Extraction of Nitrate of Soda	326
Patterson, T. L. Discussion on Viscosity Determinations	119	Puls, J. Estimation of Glycerine	177
Pattinson, J. Discussion on Use of Nitrometer	81	Pumariga, U. R. Metallised Fabrics	388
Estimation of Manganese	366	Pumpelly. Filtration of Water	646
Loss of Chlorine from Bleaching Powder	587	Punshon, R., and Beckles, S. H. Hard Material from Crokerit	35
Volumetric Test for Manganese	422	Puttner, E. v. Reduction of Magnesium	31
Test for Manganese	167		
Pattison. Discussion on Antimony Chloride	593	Quaglio, J. Compressor for Coal	317
Discussion on Tests for Oils	362	Quarterman, W. H. Galvanic Batteries	455
Discussion on Viscosity Determinations	119	Quentin, L., and Brin, A. Metal Refining	101
Pauli. White Caustic Soda	351	Quimby, E. E. Filters for Sogar Liquor	320
Peacock, W. Preservation of Fruit	105		
Pechiney, A. R., and Co. Cooler for Gases (illus.)	325	Radot, R. Decarbonation of Barium Carbonate	165
Heating Substances out of Contact with Products of Combustion	171	Decarbonation of Earthy Carbonates	324
Decomposition of Ammonium Chloride by Magnesia (illus.)	483, 487	Ramsay, W. Nickel and Cobalt Ores of New Caledonia	232
Pechmann, H. v. See Cornelius	481	Ramsay, W., and Young, S. Decomposition of Chloroform at a Red Heat	232
Peckalt, J. Japanese Medlar	218	Ramsbacher. See Muntz and Ramsbacher	81
Pedder, J. See Thwaite	379	Randolph, N. A. Inorganic Foods	613
Pet, H. See Bennett	603	Ransome, F. Cement	327
Pell, B. Manganese Battery Cells	675	Raschig, F. Action of Hydrogen Peroxide on Antimony Sulphide	39
Pellet. Percentage of Juice in Sugar Cane	453	Ratcliffe, H. T. See Wallis	373
See Champion	177	Rathke, B. Perchloromethylmercaptan	96, 320
Pemberton, E. T. Brewing	36	Rawson, C. Discussion on Chemistry of Fixed Oils	71
Pena, J. G. Artificial Fuel	595	Discussion on Materials used in Dyeing	74
Penot. Determination of Chlorine	588	Discussion on Valuation of Copper	277
Pentecost. Discussion on Antimony Mordants	362	Raydt, W. Manufacture of Ice	158
Percival, H. G. See Haylor	529	Rayleigh, Lord. Dust and Smoke	572
Perkins, J. Ice Machine	135	Read, H. S. See Haylor	539
Perkins, J. P. Paint from Slag	102	Recknagel. Water-closets in Dwellings	611
Perrel. Priority in Use of Pyrites	402	Redgrave, G. R. Treatment of Sewage	151
Perret. Sulphuric Acid from Pyrites	321	Redl, F. Refining Lubricating Oils	494
Perrins. Alkaloids of Hydrastis Canadense	677	Redwood, Bako Petroleum	472
Peters, J. J. W. Purifying Yeast	131	Examination of Oils	359
Petri, C. Ferriyanides	500	Viscosimetry or Viscometry (illus.)	121
Petri, J. See Lehmann and Petri	238	See Abel	469
Petrie, G., and F. W. Treatment of Esparto for Paper	332	Redwood, I. J. Action of Oils on Metals	362
Pettenkofer. The Hardening of Cement	189	Reece. Ice Machine	137
Pfaundler. Vacuum Pyrometer	636	Reed, A. E. Discussion on Alum Manufacture	22
Pfeffer, W. Absorption of Dyes by Living Cells	600	Reed, J. See Schnell and Reed	21
Pfeiffer and Lehman. Nitrogen Determination (illus.)	189, 550	Rees, J. P., and Parker, T. D. C. Voltaic Batteries	675
Pfister, J., Durst, E., and Vidrie, L. Preservation of Wood	492	Reffitt, J. Dyeing Apparatus	50
Pfützing, Phenylhydrazine	237	Dyeing Fabrics	97
Philip, M. See Bamberger, E.	419, 595	Reichardt, E. Determination of Nitric Acid	617
Phillip. See Fisher and Phillip	219	Reichling. Electrical Safety Apparatus for Boilers (illus.)	415
Phillips, A. G. Discussion on Valuation of Copper	278	Reid, T. A. Wood as a Paper-making Material	273, 319
Phillips, H. Discussion on Chloride of Sulphur	611	Reinitzer, F. The Etching of Glass (illus.)	609
Valuation of Calcium Acetate	457	Reinhardt, C. Determination of Manganese	391
Pick, S. Ammonia-soda Process (illus.)	129	Reis, M. A. v. Action of Carbonic Acid on "Thomas" Slag	581
Pickering. Action of Acids on Copper	85	Estimation of Phosphorus	176
Picking, G. G., Hopkins, W. H., Dore, J., and J. Vinegar	613	Reisehauer. Saccharine	516
Pictet. Ice Machine	137	Reitnair, O. See Stutzer, A.	498
Liquid for Refrigerators	139	Reitz, J. P. Bronze	382
Pieper. The "Thomas" Slag	329	Rempel, R. Formation of Bad Crude Spirit	330
Pierce, W. S. Phosphatic Manures	433	Tube for Fractional Distillation (illus.)	333
Pierret, J. E. A. Waterproof Composition	609	Renard. Examination of Oils	312
Phillvaxt, L. See Speyer	603	Rentsch, C. See Kolbe, C.	482
Piper, A. Metallic Etching	102	Retting, F. Action of Aromatic Bases on Manganese Brown	482
Piria. Naphthionic Acid	164	Revere, J. Ship-sheathing Metal	85
Thionaphthamic Acid	288	Reynolds, O. Dust	576
Pisani. Selenides	31		
Pischon, H. Preservation of Flour, etc. (illus.)	611		
Pistor, C. See Naumann and Pistor	24		
Pistor. See Naumann	370		

	PAGE		PAGE
<i>Rheinische Industrief. feuerfeste Producte.</i> Packing for		Schauschieff, A. Voltaic Batteries	500
Glover Towers	99	Scheibler, C. Alcoholic Extraction of Beet Sugar	169
Richards, W. F. Utilisation of Galvanisers' Dress	615	Precipitated Phosphate	541
Richardson, C., and Crampton, C. A. Wheat Germs	385	Scheibler, C. Extraction of Sugar from Beet	213
Richardson, C. J. Paper-making Machinery	332	Raffinose	213
Richardson, H. Alumina	128	Slag Rich in Phosphate	337
Richter and Münzer. Aceto-acetic Ether Derivatives	26	Strontium Saccharate Process	243
Rideal, S. Estimation of Nitrous Acid	633	Schenck, S. See Farbsky	615
Ridley, J. C. Steel Pots for Lead	167	Scheurer, O. Removal of Gum from Chocolate Moulds	396
Ridsdale, C. H. Apparatus for Colour Tests (illus.)	585	Scheurer-Kestner. Ammonia-soda Process	322
Riehm, P. See Engler and Riehm	238	Sulphuric Acid from Pyrites	321
Riley, F. G. Carbonic Acid Apparatus (illus.)	520	Schiff, H. Colours from Furfuraldehyde	377
Riley, J. Steel Manufacture	131	Furfuraldehyde	398
Rimpau, R. Experiments on Marsh Land with Phosphates	541	Non-metallic Gas Regulator (illus.)	175
Rindell, A., and Hannin, F. Nitrogen Determination (illus.)	550	Reactions of Rosaniline Salts	287
Rischbiett, P. Raffinose	386	Schiff, See Baejer and Schiff	236
Rischbiett, P., and Tollens, B. Raffinose	213	Schirmer, C. Conessine	501
Ritthausen, and Boehm. Sugar from Cotton Seed	213	Schlagdenhauffen. Decomposition of Urea	261
Riz, C. See Merz, V.	150	Schlagdenhauffen, F. See Don, G.	329
Robbins, E. Concrete for Building	100	See Heckel	168, 173, 175
Roberts, A. Removing Incrustation from Boilers	151	Schleselman, J. See Carney	376
Roberts, F. See Boake and Roberts	99	Schloesing, J. T. Ammonia-soda Process (illus.)	166
Roberts, F. G. A. See Boake	170	Ammonia-soda Process	322
Roberts, J. L. See Breyort and Roberts	106	Nitrogen Determination	510
Roberts, Dale and Co. White Caustic Soda	351	Solubility of Calcium Carbonate	321
Robertson, S. Filters	468	Schloesing and Rolland. Ammonia-soda Process	322
Robinson, J. Spent Oxide of Iron	32	Schmelzer, T. jun. Action of Lime on Metals	493
Rochefontaine. Dondakine	173	Schmid, J. Fisetin, the Colouring Matter of Fustic Wood	150
Roeke, H., and Tompitt, H. T. Antiseptic	439	See Lunge and Schmid	210
Rockwell, A. P. Compound for Carburetting Gas	651	Schmidt, R. E. See Lunge, G.	505
Rodda, S. See Stephens, S. H.	193	Schmidt, S. G. Reaction of Rosaniline Salts	287
Roebuck. Manufacture of Sulphuric Acid	102	Schmidtborn and Jarves, D. Ammonium Chloride	211
Rohrmann, L. See Lunge	168	Schmitz, S. Determination of Nitrogen in Coal (illus.)	506
Rohrmann, L., and Hiller, M. Absorption of Gases	423	Schnapf, E. See Jacobson, O.	25
Rommeholler, C. G. See Luhnann	326	Schneider, R. Explosions from Coal dust	167
Roscoe, Sir H. E. Address to Manchester Section	576	Schneil. Nitromethylmethoxybenzaldehyde	217
Formation of Society	402	Schneil, J. F., and Reed, J. Carburetting Air	21
Rivers Purification Bill	157	Schneider. Silk Plants	482
Rose, Crucible	292	Schoellkopf Aniline and Chemical Co., New York. Azo-derivatives of Naphthol-nitrosulphonic Acid	164
Rose. Fusel Oil in Brandy	498	Schoeneweg, H. Explosives	679
Determination of Fusel Oil	393	Schonheim. Sterilisation of Bacteria	262
Salicylic Acid in Beer and Wine	618	Schonmark, H. Manuring Experiments with Phosphates	511
Rose, G. F. Electric Batteries	676	Schoop, P. Analysis of Aniline Oils	178
Rose, P. B. See Clute	689	Manufacture of Magenta (illus.)	163
Ross, J. Leather Waste as Manure	191	Schott. Glass for Standard Thermometers	167
Ross, R. Toilet Soap	608	Schreib, H. Ammonia-soda Process (illus.)	533
Rosse, R., and Wolters, F. Hydraulic Cements	190	Schroter, L. Purifying Water for Boilers	367
Rossi. See Du Motay and Rossi	139	Schroeder, Von. Estimation of Tannin	79
Roth. Hydr Powder	81	Schultz, G. Diamidoditoly	96
Roth, C. Indamines	662	Schultze, E. Explosives	679
Roth, C. F. Determination of Melting Points (illus.)	617	Schultze. Naphtholsulphonic Acids	378
Roth, J. Examination of Oils	305	See Schulz	612
Rottger, F., and Precht, H. Determination of Sodium Chloride in presence of Potassium Chloride	40	Schulz, H. Congo Red as Indicator	511
Round. Discussion on Chemistry of Foundry Iron	295	Influence of Thalline Salts on Putrefaction	434
Rousset, C. F. Varnish for Fixing Transfers	609	Njimo Wood	501
Routledge. Use of Esparto for Paper Making	273	Schulz and Schultze. Valuation of Sugar Beets	612
Rowan. Discussion on Specific Heats of Gases	11	Schulz. See Frühling	385
Rowan, F. J. Distillation of Coal	235	Schulze, E. See Hartman	578
Rowell, G. Iron Manufacture	101	Schulze, E., and Bossard, E. Allantoin and Asparagin in Plants	385
Rowell, W. A. See Brock and Rowell	211	Non-nitrogenous Constituent of Vetches	173
Rowley. Discussion on Chloride of Sulphur	611	Schulze, K. E. Anthrapinacone	95
Discussion on Corrosion of Copper	89	Beta-Hydroxyanthranol	95
Discussion on Foundry Iron	235	Durene in Coal-tar	95
Royle, Forbes. Fibrous Plants of India	76	Schumann, C. Cement	103
Royle, V., and J., jun. Making Rubber Tubing	103	Schutze, R. Starch Waste Liquor	612
Rudolph, C., and Gurke, O. Naphthol Colouring Matters	662	Schwab, L. See Wiegelt, C.	211
Ruffle, Nitrogen Determination	510	Schwarz, H. Reactions of Zinc Dust	294
Rumble, C. Viscosimeter	121	Schweikert. See Lauber and Schweikert	97
Rumney, W., and Co. Calico Printing	606	Schweikert, L. See Lauber	165
Ruymbke, J. v. Utilisation of Waste Liquors	496	Schweitzer, W. Ethylparaphenylenediamine	319
Ryder, B. L. Drying Fruit, etc.	39	Safranines	319
		Schwitzer, H. See Liechti, L.	526
Saame. See Faust	378	Scott, A. E. Treatment of Gold Ores	431
Saare, O. See Wiegelt, C.	214	Scott. Treatment of Sewage	451
Sacker, D. N. Testing Lubricants	214	Seabury, F. W. Vulcanised Rubber	101
Sachs, O. Azo-compounds of Beta-Naphthylamine	28	Schelen, J. Albumenoids of Cows' Milk	387
Sadtler, S. P. See Sarmiento	435	Seeger. Porcelain	211
Sadtler and Silliman. Sulphur in Coal Gas	284	Seger, H. Composition of Black Clay	189
Sabli, H. "Salol"	501	Cones for Determining Heat in Kilns	490
Salamon, A. G., and Mather, W. de V. Purification of Water	261	Sellheim, P. F. Lemon-scented Iron Bark	435
Salamon, N. See Morton	676	Sellon, J. S. Secondary Batteries	106
Salomon, L. Viscosity of Oils	128	Soldering Aluminium	421
Salt. Treatment of Fabrics	533	Sellon, R. P. See Powell	511
Saltet, R. H. Fungi as Food	171	Semper and Fahlberg. Alum Salts free from Iron	20
Salzer, T. Pentathionic Acid	483	Sendtner. Acids in Butter	618
Saunderson. Detection of Artificial Colour in Claret	549	Senhouse, H. M. Coating Copper Printing Plates	331
Sandberg, C. P. Durability of Steel Rails	493	Serson, J. Galvanic Batteries	388
Sandgreen. Burner for Petroleum Residues (illus.)	471	Sestini. Photosantonie Acid	49
Sansone, A. China Grass	76	Setchells. Estimation of Antimony-potassium Oxalate	526
Sappey. Galvanic Battery	675	Seyberlich, A., and Trampdach, A. Crystallised Glucose	453
Sarmiento, F. L. and F. J. Disinfectants	435	Sharnan, C. H. Preserving Fruit, etc.	434
Sartori, G. Determination of Butter in Milk	198	Sharp, H. Waterproofing Composition	96
Saybolt, G. M. Viscosimeter	121	Sharples, S. P. Estimation of Copper	51
Saye, E. See Brock, J.	187	Shearer, A. See Giles, W. B.	689
Schaal, E. Resin-acid Esters for Varnishes	523	Sherlock, J. J. Separation of Metals	216
Turpentine	318	Shirley, F. S. Tinted and Coloured Glass	491
Schad, L. Azo-colours	523	Sichel. Polarisation of Sugar	612
Schaffer, F. Artificial Wine	170	Siebe. Ice Machine (illus.)	136
Schanschieff, A. Galvanic Batteries	247	Siegmant. Etching on Glass	669
		Siemens. Pyrometer	631
		Siemens, F. Combustion	591

	PAGE		PAGE
Siemens, F. Lining for Furnaces	608	Stinde, J. Apple Chips containing Zinc	498
Gas Furnace for Iron Ore	608	Stirling, J. D. M. Toughened Cast-iron	292
Siemens, W. Production of Ice	111	Stock, W. F. K. Estimation of Sulphur in Coal	155
Silber, See Clamician	236	Stoddard, Lemon-juice	216
Sillar, W. C. Treatment of Sewage	614	Stoehr, C. Sulpho-acids of Strychnine	171
Sillman, See Sadler	281	Stolba, F. "Vitriol Stone" and Colcothar	30
Simoad, F. and Weiss, B. Estimation of Tannin	210, 435	Decomposition of Silicates	41
Simon, H. Separation of Dust from Air	653	Stollwerck, Gebr. Germination of Barley	101
Simonsin, S. Acetophenone	388	Stone, H. Plaster Manufacture	451
Simpson, D. S. Paper for Indelible Writing	531	Stone, R. Cement	536, 594
Simpson, J. See Parnell and Simpson	33, 210	Storch, F. Fixing Colours on Cotton	322
See Parnell	112, 608	Storey, J. See Wilson and Storey	35
Sisson, Discussion on Magnesium Sulphhydrate	585	Streng, C. R. Viscosity of Oils	125
Sisson, G. jun. Pure Sulphuretted Hydrogen	210	Strype, W. G. Alum-cake	19
Skalweit, J. Estimation of Glycerine in Wine	457	Stuart, T. F. Solubility of Silver Chromate	286
Skraup, Z. H. Paraquinanisol	218	Studer, See Liebmann, A.	287
Slater, J. W. Treatment of Sewage	171, 614	Stutzer, A. Analyses of Meat Extracts	37
Slater, J. W. and Stevens, W. Purification of Sewage	38, 39	Stutzer, A. and Reimair, O. Fusel-oil in Brandy	498
Slaughter, Toughened Iron for Steam Cylinders	233	Süchmel, Alcoholic Extraction of Beet Sugar	169
Smart, W. Vulcanised Rubber	235	<i>Saccharic Induline</i> . Clarification of Syrups	169
Smith, Angus. Examination of Water	561	Lime Saccharate	453
Smith, P. Separation of Solids from Sewage	587	Suida, W. See Liechti, L.	523, 526
Smith, P. and Wild, R. Filtration of Sewage	103	See Liechti and Suida	463
Smith, T. Cement	611	Suida and Liechti. Aniline Black	237
See Chambers, A. M.	375	Sulman. Discussion on Strontia	632
Smith, W. Portland Cement	51	Sulman, H. L. and Berry, E. E. Examination of Glycerine	177
Smith, Watson. Cotton Silk of the Gold Coast	642	Swandberg, C. Pepsin	451
Discussion on British Chemical Industries	357	Swan, J. G. and R. M. W. Disinfectant Soap Compound	281
Discussion on Coal-tar Chemicals	76	Sweetser, G. A., Bell, D. W., and Bolun, W. Machine for Candles	608
Discussion on Materials used in Dyeing	71	Swete, O. R., and Main, W. C. Filaments for Electric Lamps	500
Phosphate Slag as a Manure	161	Symons, W. Secondary Batteries	106
Reactions for Resorcinol	580	Symons, W. H. Disinfectant for Closets	288
Smith, Watson, and Hart, W. B. Manufacture of Carbonate of Soda	613	Synott, T. W. Glass Furnaces	100
Smith, W. G. Lanolin	579	Szabanczew, A. Action of Sulphuric Acid on Oleic Acid	452
Smithson, S. Apparatus for Dyeing (illus.)	661	Szabasi. Milk Analysis	618
Snodgrass, J. See Neilson and Snodgrass	247	See Gritter	392
Soc. Anon. "Le Ferro-Nickel." Alloys of Iron and Steel	329	Szymanski. Separation of Albumen from Peptones	513
Soc. Anon. de Forges et Chantiers. Artificial Fuel	317	Talander. Bessemer Steel	607
Soc. a Chertemps et Cie. Carbons for Electric Lamps	451	Tammann, G. Oxidation of Sulphur in Peas	585
Soc. Leblais, Picot et Cie. Bleaching Cotton	533	Tanczos, R. Rendering Wood Incombustible	430
Soldani. Detection of Invert Sugar	612	Tanquerel. White Lead as a Cosmetic	312
Solvay, E. Ammonia Soda Process	522	Tanret. Bitter Orange Rind	390
Mechanical Production of Heat	316	Tarkenton, M. O. Discussion on Filtration of Water	225
Bleaching	351	Tarbutt, P. Combustion of Hydrocarbons	236
Solvay and Co. Chlorine from Ammonia-soda Process	151	Tasker, W. H. and Jones, T. J. Galvanic Batteries	172
Filters for Caustic Soda	121	See Jones, T. J.	500
Sommerschein, A. Nitrogen Determination (illus.)	507	Tate. Action of Saccharine	421
Drying of Fats (illus.)	508	Discussion on Valuation of Copper	279
Phosphorus Determination	707	Tate, N. Discussion on Cotton-seed Oil	205
Souhlet. Determination of Butter in Milk	198	Discussion on Redonda Phosphate	572
Extraction Apparatus	175	Discussion on Technical Education	569
Grape Sugar	510	Discussion on Wood as a Paper-making Material	219
Milk Analysis	516	Tate, W. Redonda Phosphate	570
Spackman, C. Portland Cement	381	Taylor, White Lead as a Cosmetic	312
Spady, J. Action of Isovaleraldehyde on Aniline	162	Taylor, E. Treatment of Waste Liquor from Silk-dressing	378
Spence, Aluminio-feric Cake	19	Tellier. Ice Machine	137
Spence, J. B. Sulphide of Zinc	602	Terril. Orpiment and the Removal of Hair from Hides	495
Treatment of Sewage	387	Terry, H. L. Discussion on Chloride of Sulphur	611
Zinc-white	609	Tevet. Discussion on Maumene's Test for Oils	151
Spencer. Percentage of Juice in Sugar-cane	453	Discussion on Viscosity Determinations	119
Spencer, S. See Gillman	671	Tessie du Mothay. Etching on Glass	699
Speyzer, A., and Pillivayt, L. Cements	603	Tetmajer. Slag Cement	603
Spiller. Discussion on Treatment of Water	272	Tetmajer. See Wetters and Tetmajer	211
Spohr. Pyrometer	634	Thamé, H. and J. R. Secondary Batteries	514
Sprengel. Hell Gate Explosion, New York	319	Thiel. Pasteurising	498
Sprengel, H. Pencilstite	199	Thiery, M. de. Estimation of Hydrogen Peroxide	391
Sprengel, H. J. P. Sulphuric Acid (illus.)	668	Thilo, E. Estimation of Silver in Burnt Pyrites	548
Springer, C. C. Boilers for Paper-pulp	135	Thierner, W. Petroleum as an Illuminating Agent (illus.)	371
Springmühl. Amount of Arsenic in Magenta	228	Valuation of Petroleum	651
Squire, W. S. Yeast	512	Thomas, P. Phosphoric Deposits in Tunis	189
Staedel, W. Metacresol	237	Thompson. "Concealed" as an Indicator	71
Staedel, W., and Bauer, H. Azo-compounds	596	Discussion on Chemistry of Fixed Oils	71
Staedel, W., and Holz, O. Commercial Nylidines	28	Machine for Bleaching	661
Metaxyleneol	237	Thompson, J. and Bryant, J. H. Artificial Stone	160
Stadler. See Meyer	119	Thompson, L. Caloric Value of Fuel	581
Staumer. Examination of Petroleum	176	Thompson, W. P. Cowles Aluminium Furnace (illus.)	206
Stanford, E. C. C. Alginic Acid	218	Discussion on Cotton-seed Oil	205
Discussion on Purification of Water	651	Discussion on Wood as a Paper-making Material	330
Non-conducting Composition	109	Thomson. Discussion on Chloride of Sulphur	611
Stanhope Co., The. Purification of Water (illus.)	269	Discussion on China Grass	79
Stanley. Ice Machine	137	Estimation of Rosaniline Salts	283
Starke. Serum Albumen	357	Thomson, J. Antiseptic Soap	609
Stend. Chromometer	294	Discussion on Viscosity Determinations	149
Siliceous Iron	294	Thomson, R. J. Indicators in Alkalimetry	219
Steele. Discussion on Utilisation of Tar	563	Thomson, R. S. Indicators in Alkalimetry	219
Steele, M. See Wigg and Steele	51	Thomson, R. T. Estimation of Alumina in Phosphates	152
See Wigg	536	Indicators	257
Stellon. Separation of Sugar from Molasses	612	Thomson, W. Black Spots produced on Paper by Woollen Goods	637
Steiger. Distillation of Zinc	607	Calorimeter (illus.)	581
Steiger, A. Filtration of Water	614	Determination of Stiffness of Starch Paste	113
System of Filtration (illus.)	116	Discussion on British Chemical Industries	358
Steiger, E. Substance resembling Dextrin from Lupin Seeds	385	Discussion on Soda	550
Stenbeck. Valuation of Copper	278	Indianrubber and its Decay	432
Stenhouse and Groves. Beta-Orelinol	559	Thorman, A. J. See Chablers, H. C. B.	331
Stephens, S. H., and Rodda, S. Pulverisation of Ores	493	Thorne, W. Asphalted Iron Pipes	37
Stephenson, A. Discussion on Antimony Mordants	302	Thorne and Zincke. Derivatives of Pinacolines	521
Stephenson, R. Strength of Cast Iron	590	Thorp. Discussion on Treatment of Water	272
Stenberg. Separation of Sugar from Molasses	612		
Stevens, J. See Slater and Stevens	38, 39		
Stevenson, J. C. Disinfectants	105		
Stier, H. Carbonising Arrangement	236		

	PAGE		PAGE
Thorpe, T. E. Estimation of Copper	54	Vulpinus, G. Iodoform Powder	501
Thorpe and Dalzell. Chloride of Sulphur	638	Vuylssteke, A. F. Filter Presses	521
Thorpe and Young. Distillation of Paraffin	6		
Thowless, O. M. Soldering Aluminium	423	Wagner. Solubility of Phosphatic Slag	672
Thurston, R. H. Friction of Fluids	122	Wagner, H., and Muller, A. Purifying Sewage	39
Thwaite, B. H. Preservation of Food	671	Wagner, L. v., and Gillitzer, A. Starch-making	330
Preserving Food	57	Waite, C. N. Antimony Mordants	483
Thwaite, B. H., and Padder, J. Alkali Manufacture	579	Waite. Testing Lubricants	123
Tidy, C. M. Chemical Treatment of Sewage	344	Walback. Strength of Cast Iron	290
Tidy. Filtration of Water	616	Walberg, N. Chromate of Soda	239
Micro-organisms in Water	544	Walker, A. Condensation of Lead Fume	375
Tiemann, Nitrometamethoxybenzaldehyde	247	Walker, C. M. See Green, T. A.	595
Tiemann, F. Vanillin	252	Wallace. Discussion on Purification of Water	651
Tilden, W. A. Corrosion of Copper and Brass by Saline Waters	84	Discussion on Spanish Pyrites	309
Tilden. Terpenes	8	Discussion on Testing Cement	159
Tilgmann. Treatment of Wood Pulp	274	Wallach, O., and Nietzki. Azo-compounds	481
Timewell, W. T. Cement	603	Wallis, H. E. A. Carburetter for Gas-burners	522
Tissaudier. Rust	576	Wallis, H. E. A., and Ritchie, H. T. Carburetter for Gas	523
Todd, H. W. Drums for Chemicals	421	Wallis, J. H. See Barringer, R.	595
Tollens, B. Melitose	244	Walter, J. Acridine	545
Raffinose	386	Phosphoric Anhydride	295
Raffinose in Molasses	101	Walton. Cast Iron	432
See Lippmann	386	Walton, F. Coating Wire with Oxidised Oil	285
See Rischbiel and Tollens	243	Wanklyn, J. A. Carbonic Acid in Coal Gas	79
Tompkins, J. D. Paper Pulp	45	Sulphur in Coal Gas	284
Tompsett, H. T. See Roctoe, H.	499	See Fox	546
Toselli. Production of Ice	141	Ward, A. J. Material for Pigments, etc.	609
Toth, J. Determination of Phenol	618	Waring, J. T. Treatment of Felt	378
Tower, B. Testing Lubricants	123	Warrington, R. Nitric Acid	510
Townsend, J. Soap	432	Filtration of Sewage	616
Trachsel, E. F. Hydrates of Barium and Strontium	379	Examination of Wine-lees	497
Hydrate of Strontium	33, 630	Sicilian Lemon-juice	215
Trampedach, A. See Seyberlich, A.	453	Warnerke, L. Sensitive Photographic Paper	97
Traube, J. Determination of Fusel Oil	305	Wass, A. G. Utilisation of Sugar-cane	453
Determining Fusel Oil in Alcohol	496	Utilisation of Waste Lime from Sugar	674
Estimation of Fusel Oil	546	Watson. Discussion on Chloride of Sulphur	641
Traube, M. Reaction of Carbon Dioxide with Hydrogen	24	Discussion on Valuation of Copper	277
Combustion of Carbonic Oxide	370	Watson, E. B., and Fulton, H. B. Hygienic Candles	499
Traulz. Explosives	502	Watson, G. Antimonious Chloride as a Mordant	590
Travers, T. Purification of Gas by Oxide of Iron	426	Watson, G., jun. Antimony Mordants for Calico	663
Treadwell. Use of Nitrometer	83	Watson, J. Gas Fuel for Boilers	159
Tredgold, T. Strength of Cast Iron	289	Watson, W. H. Action of Oils on Copper	362
Trygwy, G. C. Discussion on Utilisation of Tar	563	Watt, A. Saccharine	319
Tribouillet, V., and Hussen, E. Preservation of Food	674	Watts, F. Essential Oil of Lime Leaves	436
Trimble, H. Oils of <i>Mentha</i>	173	Fermentation of Citric Acid	245
Tuchschmidt. Rotation of Sugar	386	Sampling Viscid Liquids (illus.)	211
Tucker, A. E. See Jarvis, G.	329	Turmeric as Indicator for Citric Acid	214
Tucker, J. H. See Newhall, G. M.	330	Weber. Antimony Oxalate	169
Tupper, J. H. Capillary Filters	24	Antimony Hydrate as Mordant	165
Turck. Ammonia-soda Process	322	Weber, S. Red Colouration of Cotton by Aniline	322
Turner, T. Chemistry of Foundry Iron	289	Webster J. Metallic Alloy	491
Foundry Iron	106	Utilisation of Tank Waste	35
Turpin, E. Pencil-stone	199	Weeren, J. and F. Alkaline Silicates	33
Picric Acid as an Explosive	679	Wehr, G. See Pollak	455
Tursini. Dimethylaniline Sulphide	320	Weidel. Diquinoline	162
Twyman, T. Chlorine Manufacture	32	Weinberg, A. See Hoffman, M.	427
Lining for Furnaces	494	Weir, J. Obtaining Fresh Water from Salt Water	591
Phosphates from Slag	325	Weiske, H. Separation of Albumen from Peptones	543
Soluble Phosphates from Slags	379	Weismann. Alum Manufacture	18
Tyndall. Dust and Smoke	572	Weiss. See Simand and Weiss	210
		Weiss, B. See Simand, F.	495
Uffellmann. Milk Analysis	516	Weith. See Merz and Weith	96
Ulrich, M. Vanillin	247	Weith and Merz. Estimation of Paratoluidine	178
United States Waterproofing Fibre Co. Treatment of Fabrics, etc.	322	Weith. Picoline	236
Unwin, W. C. Testing Portland Cement (illus.)	188	Welch, J. T. Utilisation of Slate Rubbish	100
Upton, E. W. Metallic Thermometer	652	Weldon, W. Chemical Industries	357
Upward, A. R., and Pridham, C. W. Galvanic Batteries	247	Manganese Mud	51
Use of Chlorine in Batteries	331	Welsbach, C. A. von. Compounds of the Rare Metals	522
Urban, V. See Frey, E.	450	Incandescent Wick for Gas-burners	522
Utz, A. See Kutschera, E.	531, 532	Welsh, W. See Forest, A.	675
Uzielli, M. Ship-sheathing Metal	85	Wende, H. Creosol-carboxylic Acid	599
		Wernecke. Wash-bottle for Quantitative Work (illus.)	333
Valenta, E. Acetic Acid Test for Oils	69, 282	Werth. Carbon in Iron and Steel	493
Examination of Oils	191	West, T. D. Toughened Cast Iron	291
Vallance. Ice Machine	135	Westmoreland, J. W. Valuation of Copper Ores	48, 276
Valser. See Grandval	545	Westphal. Hydrostatic Balance (illus.)	63, 71
Varley, S. A., and Gorman, W. A. Production of Ice	22	Specific Gravity Balance	178
Vaughan, J. L. Discussion on Utilisation of Tar	563	Weygang, C. Sizing Paper	331
Vaughn, J. W. Treatment of Hides, etc.	609	Wezel, J. Artificial Lithographic Stones	99
Venables, H. Glazing China, etc.	191	Whitelaw, T. N. Action of Chloride of Sodium on Solutions of Soap	96
Venator, W. Action of Caustic Soda on Metals	381	Whitelegge. Discussion on Filtration of Water	220
Verein f. Chem. Ind. Mainz. Chlorine Manufacture	379	Whiteley. Discussion on Antimony Mordants	302
Vergara, F. See Woodbury, W. B.	456	Whittle, J. Extracting Grease from Waste	381, 608
Vial, L. E. Removing Gums from Flax, etc.	523	Wichelhaus, H. Bases of Methyl-violet	318
Vidric, L. See Pfister, J.	192	Widman. Metacresol	237
Vielle. See Berthelot and Vielle	15	Wiebe, H. F. Glass for Standard Thermometers	167
Villavecchia, V. Santonin	40	Wiedersheim, J. A. See Sarmiento	435
Ville, J. Indicators in Alkalimetry	249	Wiegelt, C., Saare, O., and Schwab, L. Injurious Action of Various Substances on Fish	214
Virchow, C. Indications of Genuine Butter	618	Wigg, C. Soda Manufacture	210
Vivian and Sons. Treatment of Copper Ore	390	Spent Copper Liquor	325
Voelcker. Redonda Phosphate	571	Wigg, G. L., Steele, M., and Wigg, W. J. Utilisation of Residual Liquors from Copper and Chlorine	31
Vogel, H. W. Isochromatic Photographic Plates	692	Treatment of Residuals	536
Voigt, C. H. Fodder from Waste Products of Paper Pulp	435	Wiggin, H., H. A., and W. W., and Johnstone, A. S. Manufacture of Nickel and Cobalt	172
Volney, C. W. Action of Oils on Brass	362	See Smith and Wild	105
Volpert. See Bruhns	547	Wiley, T. F. Waterproofing Fabrics	184
Volz, O. See Claus and Volz	29	See Hallett and Wiley	239
Vornberger, E. Manufacture of Gut Strings, Bands, etc.	381	Wiley and Hallett. Spray Apparatus	165
Vrij, J. E. de. Alkaloids of Cinchona Bark	248	Willfarth. Nitrogen Determination	179
Commercial Quinine	501		
Vulpinus, G. Quinine Bark	388		

	PAGE		PAGE
Willhoft, F. Vulcanised Soft Rubber	212	Wood. See Pontifex and Wood	137
Will, W. Constituent of Root of Peonia Montan	456	Wood, C. Influence of Silicon on Iron	291
See Freund, M.	677	Toughened Cast Iron	291
Will, W., and Beck, P. Umbelliferone	456	Wood, J. See Morris and Wood	158
Will, W., and Leymann, H. Cochineal	29	Wood, W. H. Refrigerators	24
Will and Varrentrapp. Nitrogen Determination	510	Woodbury, C. J. H. Testing Lubricants	123
Willgerodt, C. Benzene containing Thiophen	480	Woodbury, W. B., and Vergara, F. Transparent Paper	456
Willgerodt, C., and Ferks, M. Preparation of Mononitro-		Wren, W. C. Distillation of Ammonia	487
anisole	160	Wright, C. R. A. Oxides of Manganese	367
Williams. Action of Zinc-copper on Water	266	See Muirhead, A.	455
Williams, J. See Kayser	613	Oxides of Manganese	423
Williams, R. Examination of Materials used in Dyeing	72	Wright, J. Vacuum Still	331
Williams, W. J. Redonda Phosphate	570	Wright, L. T. Discussion on Filtration of Water	226
Williamson, W. Hopene	173, 248	Enrichment of Gas	3
Wilson, Pyrometer	635	Purification of Gas by Ammonia	655
Wilson, A. Gas Producer	317	What shall we do with our Tar?	558
Wilson, G. R. See Faulkner	191	Wright, W. Examination of Fixed Oils	282
Wilson, J. Decomposition of Chloride of Magnesium	99	Wright, Sulphur in Coal Gas (illus.)	284
Wilson, J. V. Testing Lubricants	121	Wrightson, J. Basic Slag as Manure	464
Wilson, W. V. Acetate of Amyl	249	Wrightson, T. See Munro and Wrightson	101
Wilson, W. V., and Storey, J. Nitrocellulose Compound	35	Wuster, J. H. Measuring Equal Quantities of Fluids	235
Wimshurst. Dust	576	(illus.)	172
Windhausen, F. Ice Machine	133	Wynne, F., and Powell, L. S. Carbons for Electric Lamps	571
Wing, J. F. See Jackson	377		
Winkler. Cements	103	Yardley, H. B. Redonda Phosphate	571
Winkler, C. Correction of Volume of Gas	116	Young, A. B. See Kayser	613
Winter, H. See Herzfeld, A.	133	Young, A. S. Calico Printing	666
Winther. See Neville and Winther	161	Young, J. Cyanogen Compounds	34
Wirth and Co. Hardening Resins, etc.	103	The Paraffin Industry	358
Witt, O. N. Aspirator (illus.)	503	Young, J. H. Preservation of Wood	34
Azo-bodies	27	Young, S. See Ramsay, W.	232
Dinitronaphthylamine	597	Young, W. C. Sulphur in Coal Gas	284
Discrimination of the Organic Colouring Matters	249	Young, Solid Caustic Soda	283
The Eucharoides	320, 577	See Thorpe and Young	6
Filter	191		
Filtering Apparatus	510	Zacharewicz, E. See Audouynaud	541
Naphthylaminesulphonic Acids	161, 376	Zalinski, E. L. Fuses for Shells	679
Alpha-Naphthylaminesulphonic Acid	419	Zanastovic, W. Paramethylisatoic Acid	237
Safranine	319	Zanoni, Beta-Picoline	95
Toluyene Blue	599	Zega, A. See Hatschek	161
Toluyene Red	661	Zega and Buch. Action of Aniline on Orcinol	599
Tropaeoline as Indicator	437	Zeisel, S. Determination of Methoxyl	335
Use of Oxalate of Antimony	71	Zeiss, C. Portable Saccharimeter (illus.)	8
Witz, Hydro-oxy-cellulose	322	Zimmermann, J. See Dornstedt, M.	236
Oxy-cellulose	239	Zinke, See Thorner	321
Witz, G., and Osmund, F. Oxy-cellulose	546	Zinke, Th. Azo-compounds of Beta-Naphthylamine	28
Wochler. Etching on Glass	669	Zingler, M. Substitute for Leather	433
Wolf. Invert Sugar	517	Zinn, G. Application of Electricity to Silvering	246
Wolf, J. Carbonate of Ammonia with Alumina Mordants	165	Zittauer, Maschinenfabrik, and Eisengiesserei. Aniline	666
Wolff. Determination of Manganese	392	Black	70
Wolff, F., and Co. Purifying Water	39	Zsigmondy. See Benedikt and Zsigmondy	177
Wolters, F. See Rosse and Wolters	100	Zsigmondy and Benedikt. Estimation of Glycerin	214
Wolters and Tetmajer. Puzzuolana Cement	211	Zuñi, Substitute for India-rubber	452
Wood, Foundry Iron	606	Zwierzina, E. See Koffler, F. W.	

INDEX OF SUBJECTS.

	PAGE		PAGE
Accumulators, Electrical.	105, 246, 217, 331, 455, 514, 615, 676	Aluminium Sulphate, Detection of Free Sulphuric Acid in	617
Acetamide, Beta-Picoline from	585	Alumino-ferric Cake	19
Acetanilide	580	Amido-alizarin, Derivatives of	596
Acetic Acid Manufacture (illus.)	31	Amido-azobenzene	596
Acid Test for Oils	69, 282	Amidohrucine	391
Acetone, Action on Aniline	238	Amidodiphenylsulphonic Acid	376
Acetone-dicarboxylic Ether, Orcinol from	481	Amide Powder (an Explosive)	678
Acetophenone as a Hypnotic	388	Ammonia Carbonate used with Alumina Mordants	165
Acetopropionic Acid from Sugars	673	In Coal Gas, Estimation of	253
Acid, Removal of Waste, in Purification of Mineral Oils	160	From Coke, or Shale Coke	257
Taps and Valves	368	Dissolved in Glycerine for Ice Machines, etc.	235
Acids, Congo Red as Indicator for Free	511	Distillation of	167, 487
Distributor for (illus.)	487	From Galvaniser's Dross	615
Indicators for	392	Loss of, from Manure prevented by Gypsum	611
Treatment of Waste, from Purification of Naphtha	160	Manufacture	235
Etc., Valves for	159	Nitrate Manufacture	325
Aconite, North American	218	Process of Gas Purification (illus.)	415
Aconitine	390	As Reagent for Double Ketones	180
Aconitum Napellus, Alkaloids of	171	Soda Process (illus.)	166, 128, 129, 210, 533, 668
Acridine	595	Soda Process, Development of	413
Address of President at Annual Meeting	401	Soda Process, Origin of	322
Adulteration of Organic Colouring Matters	250	Still (illus.)	667
Agriculture, Use of Ferrous Sulphate in	133	Vapour Tension of	131
Air-blast Pyrometer	91	Ammoniacal Liquor, Composition of	635
Air, Carburetted	651	Liquor, Distillation of (illus.)	379
Carburetter for	522	Ammoniated Soap	329
Distillation by Means of Heated	40	Ammonium Bichromate	487
Filtration of	368	Chloride Decomposed by Magnesia (illus.)	483, 187
Fluids forced by Compressed	368	Chloride Manufacture	32, 241
Freed from Dust	653	Iethyolsulphonate	332
Gas	21	Nitrate, Solubility of Silver Chromate in	286
Oxygen and Nitrogen obtained from	40	Sulphide, Sulphuretted Hydrogen from	33
Pump for Laboratory Use (illus.)	503	Thiosulphate formed in Gas-generators	470
Of Schools and Dwellings	513	Amyl Acetate	249
Scrubber or Cleanser for	317	Analysis by Means of Electrolysis	351
Separating Dust from	231	Anchietine	390
Separation of Dust from	594	Aniline, Action of Acetone on	238
Thermometer (illus.)	509	Action on Manganese Brown	482
Treatment of Liquids with	105	Black	237, 663
Albumen, Blood	378	Black on Woven Fabrics	666
Reaction for	393	Condensation of Butaldehyde with	161
Separated from Peptones	513	Condensation of Isovaleraldehyde with	162
Alcohol, Determination of Fusel Oil in	498, 496	Furfuroaphthionate	377
Still for	613	Isomer of Benzidine formed from	317
Utilisation of Carbonic Acid from Manufacture of	92	Method of Estimating Nitrous Acid	633
Alginic Acid	218	Oils, Analysis of	178
Alizarates of Iron and Chromium	522	On Orcinol, Action of	549
Alizarin, Phthalenylamido	595	And Perchloromethylmercaptan Compounds	320
Present Price of	351	Red Colouration of Cotton produced by	322
Valuation of	72	Titration of	679
Alkali, Export of	355	Animal Fibre, Distinguishing Vegetable from	508
Metals, Production of	601	Animalcule, Free Acid in	511
Process, Employment of Hydrocarbons in	379	Anisol, Mononitro-	160
Trade, State of	102	Anona, Drugs from	332
Waste, Treatment of	167	Anthracene, Oxidation Product of	95
Waste, Treatment of Vines with	169	Anthracenes, Synthesis	321
Alkaline Carbonates, Silicates decomposed by	41	Anthragallol, Methyl-	599
Leys, Purification	325	Anthrapinacone	95
Silicates, Manufacture	33	Anthraquinone, Anthrapinacone from	95
Sulphates, Treatment of	167	Antifebrin	580
Alkaloids, Colour Reactions of	437	Antifouling Composition	102, 510
Reagent for	510	Composition for Ships, etc.	329
Alkanet Dye, Detection of	30	Antimonial Ores, Treatment of	323
Allanton	385	Antimonious Chloride as Mordant for Coal-tar Colours	590
Alloy for Mercurial Gilding	35	Antimony Chloride, Treatment of Dye-baths when using	663
Metallic	431, 452, 494	Lactate as a Mordant	183
Alum Cake	428	Mordants used in Hosiery Dyeing	301
Cake, Valuation of	73	Oxalate	239
Clay, Analyses of	17	Oxalate, Potassium, as a Mordant	165
Alumina	428	Oxalate, Value as Mordant	71, 97
Commercial Sulphate of	16	Oxide, Solubility in Alkaline Solution of Glycerine	165
Determination	41, 550	Potassium Oxalate, Estimation	596
Determination of Iron in Presence of	507	Production in Banyas	671
Estimated in Phosphates	152	Production in Blast Furnaces	328
Estimated in Presence of Phosphoric Acid	176	Sulphide, Action of Hydrochloric Acid on	20
Mordants, Carbonate of Ammonia used with	165	Antipyretic (Salol)	578, 580
Mordants on Cotton	331	Antiseptic	451
Titration of Soda in Presence of	679	Compound	499
Aluminium	608, 616	Preparations, Granulated	241
Alizarates	525	Saccharine as an	616
Alloys	209	Soap	609
Bronze	608, 616	Antiseptics	388
Chloride, Timber Preserved with	670	Apomorphine Hydrochloride, Colouration of Solutions	173
Electric Furnace for (illus.)	206	Apple Chios containing Zinc	498
Estimation in Presence of Phosphoric Acid	249	Aqueous Vapour, Influence on Oxidation of Hydrogen	211
Fatty Compounds as Thickeners for Oils	539	Arabinose, Action of Dilute Acids on	36, 673
Iron Alloy	329	Arbutin	332
Iron Separated from	41	Archil Paste, Detection of Magenta in	286
Mordants	526	Argol, Examination of	497
And Sodium Chloride	608	Aromatic Bases, Action on Manganese Brown	482
Soldering	431, 491	Arsenic Acid Determination	391, 510
Stearate for Thickening Oils	608	Detection of	617

	PAGE		PAGE
Arsenic, Detection of Traces in Water	84	Bleaching Compound	666
Determined in Iron Ores	547	Cotton, etc.	533
Determination in Ores	510	Fats, etc.	509
Eliminated from Hydrochloric Acid	602	Influence on Turkey-red Dyeing	239
Method of Freeing Alum Cake from Iron	20	Machine	322
Removed from Hydrochloric Acid	534	Oil, etc.	35
In Spanish Pyrites	296	Powder, Export of	356
Sulphuretted Hydrogen Free from	40	Powder, Rate of Loss of Chlorine	587
Arsenical Ores, Calciner for	428	Powder, Statistics of	412
Ashes, Purification of Water by Vitriolised	199	Powder, Valuation of	73
Asparagin	385	Blood, Utilisation of	675
Asparagus, Coniferin and Vanillin in	243	Blue Colours, Discrimination of	252
<i>Aspergillus Oryza</i> , used in Brewing by Japanese	170	For Laundry Purposes	523
Asphalt Varnish for Leather	609	Bluish-Black Colour	523
Atmosphere, Purification of (illus.)	572	Boiler Incrustation Preventive	94
Atropa Belladonna, Constituents of	456	Boilers, Anti-incrustator for	454
Belladonna, New Constituent of	249	Electrical Safety Apparatus for (illus.)	445
Atropine, Action of, as a Poison	352	Fusible Plugs for	233
Aurantiamarin	390	Gas-firing for	159
Auriferous Ores, Treatment of	494	For Paper Pulp	135, 676
Pyrites, Treatment of	382	Purifying Feed Water for	233
Autoclaves, Apparatus for Emptying (illus.)	652	Water Feeder for	367
Azobenzene Derivative	523	Bones, Extraction of Fat from	672
Azo-bodies, Bromo- and Nitro-derivatives	598	Bordeaux Red	164
Preparation of	27, 28	Boric Acid as an Antiseptic	613
Azo-colours	525, 595, 597	Brandy, Composition of	542
From Diamines	181, 182	Estimation of Fuel Oil in	546
From Naphthylamine	127, 428	Brass, Action of Oils on	262
Produced on Cotton	600	Corrosion by Saline Waters and Acids	84
Produced on Fibre	96	Bread	171
Azo-compounds	596	Breeze, Arrangements for Burning	425
Mixed	26	Breweries, Fuel Consumed in	612
Azo-dyes	428	Brewers' Grains, Treatment of	542
Azo-naphthalene	258	Brewing	36, 104, 244
Azo-opiamic Acid	319	Hops Saved in	453
Azophenylene	661	Japanese	170
Azophosphines	523	Materials, Testing	542
Azotometer (illus.)	505	Potassium Isobisulphite Used in	170
		Utilisation of Spent Hops	244
Bacteriological Examination of Water	334	Bricks from Carbonaceous Clay	671
Bacteriology	261	Refractory	102
Baku Petroleum (illus.)	472, 480	Brimstone, Comparison of Pyrites with	98
Bakul	661	Bromine Absorptions of Oils	68, 282
Balance, Westphal's Hydrostatic (illus.)	65	In Sea Water, Amount of	40
Balances, Chemical	219	Bromazobenzene	598
Barium Binoxide	428	Bromopseudoecumenesulphonic Acids	375
Carbonate, Decarbonation of	165, 324	Bromosuccinic Acid, Inactive Malic Acid from	240
Chloride and Hydrate	430	Bronze	282
Hydrate	379	Brucine	390, 616
Oxide, Manufacture of Anhydrous	31	Burettes, Gas (illus.)	285
Barley, Germination of	104	Butaldehyde, Condensation with Aniline	161
Raffinose in	36	Butter, Detection of Artificial	618
Sugars in	36	In Milk, Determination of	198
Barometer, Influence on Blast Furnaces	168	Rancidity of	542
Basic Cinder, Manurial Value of	640	Treatment of Rancid	613
<i>Bassia</i> , Gutta-percha from	168	Butylaniline, Normal	161
<i>Bassia Parkii</i> , Gutta-percha from	329		
Batteries, Cement for Electrical	172	Cadmium, Separation from Copper	510
Elements for	615	Separation of Zinc from	41
Galvanic	247, 388, 455, 456, 511, 545, 675, 676	Calcination of Spanish Pyrites	296
Galvanic and Secondary	106, 331, 509	Calciner for Ores	167, 428
Insulating Material for	172	Calcium Acetate, Action on Ferric Alizarate	521
Regulating supply to Electric	616	Acetate, Valuation of	457
Secondary	246, 247, 454, 544	Alizarates	325
Thermo-electric	561	Bisulphite	31
Bauxite, Analyses of	17	Carbonate, Dissociation of	483
Beer, Apparatus for Raising	244	Carbonate, Solution in Carbonic Acid	324
Charged with Carbonic Acid	36	Chloride, Chlorine made from	32
Detection of Salicylic Acid in	618	Chloride, Utilisation of Liquors	35
Finings	613	Oxide, Solubility of	450
Finings for Beer	674	Phosphates from Slag	537
Glycerin Estimated in	457	Saccharate	453
Liquorice Detected in	508	Calico Printing on Both Sides	666
From Maize, etc.	453	Calorimeter (illus.)	159, 581
Non-intoxicating	404	Candles	608
Returns, Treatment of (illus.)	434	Hygienic	499
Worts, Acrating	674	Cane Sugar, Honey adulterated with	479
Beet, Extraction of Sugar from	243	Caoutchouc Manufacture	495
Juice, Influence of Alkalinity	612	Solubility of	168
Juice, Valuation of	612	<i>Carapa</i> , Drugs from	310
Melitose present in	169	Carbolic Acid, Discolouration of	160
Root Seeds, Germination of	212	Acid, Estimation of Phenol in	547
Sugar, Alcoholic Extraction of	169	Acid Manufacture	426
Bellit (an Explosive)	457	Acid, Valuation of	618
Benzene, Annual Consumption of	351	Carbon Alum for Treatment of Sewage	451
Containing Thiophen	480	Bisulphide Manufacture	167
Vapour Tension of	3	Determination by Chromic Acid	617
Benzenetrissulphonic Acid	377	Determination, Combustion Tube for (illus.)	333
Benzenoid Hydrocarbons	374	Dioxide, Behaviour with Hydrogen	139
Benidine Azo-colours	597	Dioxide used with Sulphur Dioxide in Ice Machines	431
Isomeric, formed from Aniline	317	Element of Batteries	531
Benzoic Acid, Reagent for	393	Filaments for Electric Lamps	615
Benzenophenone, Homologues of	321	In Iron, Colour Test for (illus.)	586
Trimethyldiamido	318	In Iron and Steel, State of	493
Benzoylsulphimide	75	Monochloride	232
Benzylhydroxanthranol	26	From Shale used with Sewage Sludge	675
Beverages, Lactic Acid used in	616	In Steel, Condition of	538
Bichromate of Soda Manufacture	33	Carbonates, Testing (illus.)	115
Bichromates, Valuation of	72	Carbonic Acid, Action on Slag	520, 667
Bilberries, Citric Acid from	240	Acid Apparatus (illus.)	36
Bituminous Products, Hardening	103	Acid, Beer charged with	36
Black Substance from Spent Lime of Sugar Works	674	Acid in Coal Gas, Estimation of	285
Blast Furnaces, Cyanogen Products from	334	Acid lost during Fermentation, Value of	92
Bleaching Apparatus (illus.)	661	Acid Manufacture	668

	PAGE		PAGE
Carbonic Acid, Measurer for Liquid (illus.)	326	Cocaine	174
Acid, Solution of Calcium Carbonate in	321	Artificial Formation of	10
Acid, Washing Precipitates in Air free from (illus.)	307	Reactions for	335
Oxide and Hydrogen, Combustion of	370	Coccerin from Living Cochineal	319
Oxide, Preparation of	391	Cocethyline	40
Oxide and Water, Reaction at High Temperatures	21	Cochineal, Coccerin from Living	319
Carbons for Batteries	515	Constitution of	29
For Electric Lamps, etc.	172, 451	Dyeing with	528
Carburetter for Coal Gas	522	Codeia, Production of	332
For Gas and Air	24, 373	Cerulein, Dyeing with	528
Carburetting Compound	651	Coke, Condition of Sulphur in	521
Gas	236	Determination of Nitrogen (illus.)	506
Carmine, Bromo	29	Estimation of Sulphur in	154
Castings, Malleable	607	As a Filtering Medium for Water	262
Cast-iron Pipes, Tarrad	37	Heating Value of	425
Cells, Absorption of Dyes by Living	600	Ovens	375
Cellulose extracted from Wood	106	Value in Blast Furnace	167
Cement	100, 101, 327, 328, 381, 536	Coke and Tar mixed as Fuel for Gas Generators	171
Damp-proof and Luminous	327	Coking, Coal Compressed for	317
From Debris of Roads	671	Colcothar, Composition of	30
Effect of Adulterations on	196	Collars, Cuffs, etc., made from Nitrocellulose	35
From Furnace Slags	241	Colonies of Microphytes in Water	114
The Hardening of	492	Colouring Matter from Cotton-seed Oil	205
Influence of Magnesia in	492	Matters	661, 662
Kiln	100, 605	Matters, Azo, from Paranitraniline	523
Manufacture	31, 151, 594	Matters, Detection of Organic	219
Mixed with Slag, Influence of Frost on	492	Colours, Influence of Steaming on Fastness of	532
Testing Portland (illus.)	188	Influence of Substitution on Shade of	597
Cements	602, 603, 604	Combustion	594
Centrifugal Machines	91	Determination of Heat of (illus.)	159
Machines, Use of	61	Compression, Heat produced by	516
Cereals, Sugars of	36	Concrete	100, 381
Cerite, Treatment of	522	Condenser for Gas	24
Cerium Salts, Purification of	522	Cocessine	501
Charcoal, Animal, Influence of Heat on Action of	167	Congo Red	419, 595
Value in Blast Furnace	351	As an Indicator	73, 511, 679
Chemical Industries, British	419	Coniferin in Asparagus	243
Chemicals, Comparative Values of	17	Copper, Actions of Oils on	363
China Clay, Composition of	76	Assay of Gold in	63
Grass	162	Corrosion by Saline Waters and Acids	81
Chinese Green	391	Detection of Traces in Water	84
Chlorides, Action on Antimonious Chloride as Mordant	480	Electrolytic Estimation of	54
Chlorine, Action on Benzene	451	Extraction from Pyrites	403
From By-product of Ammonia-soda Process	32	Ores, Valuation of	276, 277
From Chloride of Calcium	286	Oxide Asbestos used in Combustions (illus.)	333
Determination	587	Plates, Nickel-coated	331
Lost from Bleaching Powder	379, 402	Precipitate, Production from Spanish Pyrites	296
Manufacture	31	Precipitates, Purification of	242
Manufacture, Treatment of Liquors from	536	Production in Russia	683
Manufacture, Treatment of Residuals	457	Separation from Cadmium	510
Naphthol as a Test for Free	331	Valuation in Ores	48
Chloroform added during Fermentation	389	In Vines treated with Sulphate	169
Manufacture (illus.)	232	In Vines after Treatment	496
Products of Decomposition at Red Heat	578	Residuals, Utilisation of	325
Cholesterin	247	Wet Assay of	276, 277
Choline	167, 239, 241	Works, Treatment of Liquors from	31, 431
Chromates, Manufacture	605	Works, Treatment of Residuals	536
Chrome, Iron and Steel	617	Coprolite Deposits in Tunis	169
Chromic Acid, Carbon Determination by Means of	32, 523	Cord, Polishing Material for	672
Chromium Alizarates	586	Cordage, etc., rendered Waterproof	322
Chromometer (illus.)	532	Cork, Artificial	550
Chrysamin as a Mordant	456	Corundum, New Source of	210
Chrysotropic Acid	173	Cotton, Alumina Mordants on	531
Cinchona Bark, Africa (so-called)	248	Antimonious Chloride as Mordant on	590
Bark, Alkaloids of	210	Azo-Colours produced on	600
Citric Acid from Bilberries	215	Etc., Bleaching	533
Acid, Fermentation of	214	Fabrics Printed on Both Sides	666
Acid, Turmeric as Indicator for	456	Red Coloration produced by Aniline Vapour	322
Citrus Limetta, Oil of	519	Seed, Raffinose from	213, 386
Claret, Detection of Artificial Colour in	489	Seed Oil Refining	210
Clay, Analyses of	105	Silk of the Cameroons	612
Carbonaceous. Prepared for Filters	100	Waste, Extracting Grease from	608
Mill	671	Waste, Treatment of Dirty	671
Utilisation of Carbonaceous	165	Crank Pins, Pressure on	123
Cleansing and Washing, Fluid for	173	Creosol-carboxylic Acid	599
Clover, Nitrogenous Constituent of	558	Crotonylene	374
Coal, Annual Consumption for Gas	141	Crucibles	102, 382
Composition of South Staffordshire	317	Crystals extracted from Liquors during Evaporation	24
Compressed for Coke Ovens	521	"Cuirette" (Artificial Leather)	495, 496
Condition of Sulphur in	506	Cupels made of Magnesia	538
Determination of Nitrogen in (illus.)	167	Cupola with Steam Blast	451
Dust, Explosions caused by	236, 651	Customs Regulations	680
Dust, Utilisation of	154	Cyanogen Compounds, Manufacture	34
Estimation of Sulphur in	285	Products from Blast Furnaces	334
Coal-gas, Ammonia and Carbonic Acid in	655	Cymene in Rosin Spirit	595
Ammonia Purification of	522	Dehydrodivanillin	252
Carburetter for	373	Dehydromorphine	617
Enricher for	2, 424	Depilating Hides	609
Enrichment by Hydrocarbons	283	Desiccator, with Vacuum and Heater (illus.)	175
Estimation of Sulphur in (illus.)	13	Detergent	600
Explosion with Air	5	Dextrose, Action of Dilute Acids on	673
Extraction of Benzene from	653	Diabetes, Value of "Saccharine" in Cases of	76
Influence of Oxygen on Yield	522	Diamines, Azo-colours from	481, 482
Purification of Domestic Supply	95	Colours from Oxidation of Thio-bases of	164
Purifier	235, 246	Diazo-oxyacrylic Acid	381
Coal, Retort for	318	Dibromonaphthylamine	26
Coals, Carbonising with Recovery of By products	178	Dicthylaniline, Metamido- and Metanitro-	319
Coal-tar Colours in Wine	351	Digestion, Influence of Foods on	244
Derivatives, Prospects of	45	Digitalin	501
Durene in	160	Dihydroxydimethylanthraquinones, Isomeric	25
Thickening of	558	Diiodovinylamine	384
Utilisation of	172	Diethylallene	374
Cobalt, Manufacture	618	Dimethylaniline, Metamido- and Metanitro-	319
And Nickel, Separation			

	PAGE		PAGE
Dimethylaniline, Nitration of	376	Etching on Metals	102
Dinaphthylene	238	Ether, Vapour Tension of	134
Dinitrodurylic Acid	25	Viscosity of	149
Dinitronaphthol, Detection of	437	Ethylparaphenylenediamine	319
Dinitronaphthylamine	507	Ethylsulfaniline	319
Dinitropyromellitic Acid	25	<i>Eucalyptus Manna</i> , Raffinose from	213, 386
Dixytartaric Acid, Colours from	427	<i>Eucalyptus Staigeriana</i>	436
Diparaxylylcarbinol	320	<i>Eupatorium</i> , Drugs from	332
Diparaxylylketene	320	Eurhodines	320, 377
Diphenyl, Azo-dyes from	376	Eurhodol	320
Diphenylamine, Acridine from	395	Evaporating Apparatus (illus.)	316
Diphenylamine Reaction in Milk Analysis	618	Liquors	24
Reaction in Milk and Wine Analysis	516	Evaporation, Heat Abstracted by	133
Diphenyl-naphthaquinoxaline	26	Evaporator for Sea Water, etc.	521
Dipiperidyl formed from Nicotine	40	For Solutions, etc.	368
Dipendocumamol	27	Excitant, Solid Battery	676
Dise Stirrer in place of Glass Rod	80	Excreta, Treatment of	387, 675
Disinfectant	103, 499	Exhibition, Manchester Jubilee	577, 637
Composition	381	Explosion of Gases, Pressure caused by	12
Tablet	388	Temperature of	12
Disinfectants	434, 435	Explosions caused by Coal Dust	167
Disinfection of Sewage	614, 615	Explosive	546
Dissociation of Calcium Carbonate	483	Mixtures, Sprengel's	199
Distillation, Evils of Uninterrupted	330	Explosives	457, 502
Fractional (illus.)	333	Analysis (illus.)	677
By means of Heated Air	40	Manufacture and Treatment of	678, 679
Of Spirit under Diminished Pressure	331	Sprengel's	349
Distillers' Grains, Treatment of	512	Stability on Heating (illus.)	436
Distilling Apparatus (illus.)	234	Extraction Apparatus	175
Domestic Supply of Coal Gas, Purification of	522		
Donndake, Constituents of	435	Fabrics, Material for Dressing	672
Donndakine	173	Metallised Woven	388
Drinks, Non-Alcoholic	453	Treating and Washing	322
Drugs, New	332	Factories, Purification of Refuse Water from	543
Drums for Caustic Soda	666	Factory Drainage, Influence of, on Fish	214
For Soda, etc.	421	Fat extracted from Bones	672
Drying Apparatus for Laboratories	334	Fats, etc., Bleaching	609
Machine for Wool, etc.	322	The Drying of (illus.)	508
Oven for Laboratories	106	Examination of Oils containing Unsaponifiable	179
Durene, Action of Sulphuric Acid on	375	Mineral Oils estimated in	457
In Coal Tar	95	Saponification of	384
Derivatives	25	Specific Gravity of	67, 71
Durenequinone	25	Fatty Acids, Determination in Oils	311
Durenol	25	Feed Water for Boilers, Purifying	233
Dust, Air cleansed from	368	Felspar, Analysis of	489
Condensed by Electricity	172	Felting	378
Electrical Deposition of (illus.)	65, 572	Fennugreek Seeds, Alkaloids from	217
Separated from Air, etc.	231, 394, 653	Fermentation	331
Dwellings and Schools, Air of	543	Of Citric Acid	215
Dwellings, Water-closet System in	614	Influence of Thalline Salts on	434
Dye (Hematein)	600	In Pure Air	674
Dye-baths, Treatment for Antimony Chloride	603	Ferments, Preparation of	105
Dye-liquors, Ink from Waste	427	Ferriocyanides produced by Electrolysis	500
Dyeing	30	Ferro-Coke Filters for Water	264
With Alizarin	524, 528	Ferro-Phosphor	102
Apparatus (illus.)	661	Ferrocyanide Method of Freeing Alum Cake from Iron	20
Machine	97	Ferrous Oxide, Action on Vegetation	385
Machine for Woven Goods (illus.)	230	Fertilisers	433
Machine for Yarns, etc.	239	Fibre, Azo-colours produced on	96
Materials, Examination of	72	Distinguishing Animal from Vegetable	508
Silk, Wool, etc.	533	Etc., Gummy Matter removed from	428
Dyes, Absorption by Living Cells	600	Fibres, Treatment of Vegetable	161, 450
Export of German	353	Filaments for Electric Lamps	500
Fixation by Antimony Compounds	97	Filter (illus.)	423, 611, 621
Skin Irritation not caused by	301	Filters, (illus.) 368; 22, 23, 24, 105, 245, 246, 388, 441, 445, 468, 469	510
Dyestuffs	662	Filtering Apparatus	105
Adulterations in	286	Materials	262
Dynamic employed nt Hell Gate, New York	319	Filters, Efficacy of	391
		Filter for Laboratory Use	501
Egonine, Cocaine formed from	40	Self-regulating (illus.)	424
Education, Technical	565	Filters for Soda Liquor	671
Elaudin Reaction, The	339	Filter for Sugar Juice	350
Test for Oils	304	Filters for Sugar Liquor	101
Elastic Material	452	For Sugar Solution	233, 368, 441, 445, 469, 521
Electric Arc, Metals manipulated by	675	Filter Presses	416
Heat Indicator	316	Filtration of Large Quantities of Water (illus.)	171, 674, 675
Lamps, Carbons for	451	Filtration of Sewage, etc.	223, 644
Lamps, Filaments for	500	Of Water (illus.)	613
Lamps, Incandescent	511	Finings for Beer, etc.	674
Lamps, Material for Carbons	172	For Sour Beer	102
Electrical Deposition of Dust (illus.)	572	Fire Bricks	489
Deposition of Dust and Smoke	65	Fireclay, Analyses of	379
Deposition of Precipitates	388	Fire caused by Nitric Acid	96, 480
Purposes, Insulating Compound for	455	Fireproofing Composition	281
Safety Apparatus for Boilers (illus.)	445	Fire-resisting Cement	430
Treatment of Wines, etc.	453	Fisetin	430
Electricity, Smoke and Dust Condensed by	172	Fish, Influence of Drainage on	211
Electrodes from Carbonaceous Clay	671	Flashing Point of Petroleum	371
Electrolysis, Arrangement for Continuous	615	Flask, Fractionating (illus.)	631
Stand for (illus.)	499	For Gelatine Water Test (illus.)	114
Elbow Apparatus for (illus.)	500	Flour, Alkaloids in Old	171
Electrolytic Analysis	334	Paste, Determining Stiffness of	113
Formation of Ferriocyanides	500	Preservation of (illus.)	611
Reduction of Metals	331	Fluids Forced by Compressed Air	368
Separation of Metals	216, 675	Friction of	122
Separation of Zinc and Cadmium	41	Flux containing Chloride of Calcium	35
Treatment of Metals	451	Fodder from Waste Products of Paper-pulp	435
Treatment of Ores	431	Food, Edible Fungi valueless as	171
Treatment of Sulphides	99	Preservation of	37, 613, 671
Engine, Vapour and Hot Air Combined	316	Value of Inorganic Salts as	613
Eukines, Glycerine Solution of Ammonia used for	235	Foods, Influence on Digestion	214
Enrichment of Coal Gas	424	Inorganic	613
Esparto, Paper-pulp from	276	Formic Acid, Dibromhydroxycarboxybenzoyl	30
Esters or Ethers of Mineral Acids	523	Acid from Sugars	673

	PAGE		PAGE
Friction of Liquids and Solids	122	Globulin	387
Fruit, Preservation of	105	Glover Towers, Packing for	99
Fruit, etc., Preservation of	131	Glucose, Crystallised	453
Fuel, Artificial	317, 425, 427, 395	And Sucrose, Average Percentages in Sugar Cane	117
Blocks	236	Glycerin, Alkaline Solution of Antimony Oxide in	165
Comminuted	654	Ammonia Gas Dissolved in	255
Consumed in Breweries	612	Examination of Commercial	177
Determination of Calorific Value (illus.)	581	Manufacture	381, 431, 452
Patent	373	Still	329
Fuller's Earth employed to Bleach Fats	609	Valuation of	73
Fungi valueless as Food	171	Determination in Oils	282
Furfuralcohol	598	Determination in Oils and Fats	70
Furfuraldehyde, Colours from	377, 598	Estimated in Wine and Beer	157
Furfuronaphthylene	377	Determination	516
Furnace, Blast	607	Estimation in Wine	509
For Burning Tar	561	Glycerol. See Glycerin.	
Value of Charcoal and Coke in Blast	167	Gold Assay in Bar Copper	63
Furnaces fired with Tar	125	Employed in Colouring Glass	191
For Glass	100	Ores Treated by Galvanic Action	431
Heated by Hydrocarbons	236	Treatment of Ore containing	382
Hydrocarbon Feeder for (illus.)	471	(Chloride as Reagent for Albumen	393
Lining for	102, 608	Grain Gelatinised for Brewing	101
Lining for Metallurgical	491	Grass and other Fibres, Removal of Gum from	533
Regenerative	431, 591	Graduated Vessels with Strips of Opal Glass	652
For Smelting Pyrites	168	Grease extracted from Cotton Waste	608
Fusel Oil in Alcohol, Determination of	496, 498	Purification of	35
Estimation	393	Removed from Substances	102
Fuses for Explosive Shells and Torpedoes	679	From Wool, Composition of	539
Fusible Plugs for Boilers	253	Greasy Waste, Treatment of	383, 381
Fustic, Dyeing with	528	Green Colours, Discrimination of	252
Wood, Colouring Matter of	450	Schweinfurt	596
Fustin	450	Guaiaicum as Reagent for Turpentine Oil	393
		Guaiaum	385
		Gum removed from Chocolate Mordants	596
		Removed from Grass and other Fibres	523
Galactose, Action of Dilute Acids on	36, 673	Gummy Matter removed from Fibre by Pepsin	128
In Plants	386	Gunpowder Manufacture	157
Galvanised Iron, Treatment of Waste	151	Gut Prepared for Strings, etc.	384
Galvanisers' Dress, Utilisation of	615	Guttapercha from <i>Bassia</i>	168
Galvanising	101	From <i>Bassia Parkii</i>	329
Bath	172	Substitute for	221
Gamboge, Detection of	171	Gypsum preventing Loss of Ammonia from Manure	611
Gas Burner, Welsbach's	581	Sulphuric Acid made from	189
Burners, Atmospheric	535		
Burners, Incandescent	418, 522	Hamatein	600
Burettes (illus.)	285	Heat of Combustion, Determination of (illus.)	159
Carburetted	651	Electrical Battery actuated by	456
Carburetter	21	Produced by Compression of Air	316
Carburetting or Enriching	236	Regulator (illus.)	519
Condenser	21	Heating out of Contact with Products of Combustion	171
Engines, Phosphuretted Hydrogen as Igniter with	471	Oven for Laboratories	106
Fires for Boilers	159	Hercules Metal	209
Furnace for Iron Ore	608	Hesperidin	390
Furnaces	591	Hexachlorethane	232
Furnaces for Treatment of Ores, etc.	426	Hexachlorobenzene	232
Generator	95	Hexane, Action of Heat on	373
Generators, Ammonium Thiosulphate formed in	470	Hexylamylquinoline	161
Generators, Mixture of Coke and Tar as Fuel for	471	Hides, Removal of Hair from	495
Holder, Balanced (illus.)	472	Tanning	433, 510
Hydraulic Mains	317	Tawing	433
From Hydrocarbons	418	Treatment of	609
From Hydrocarbons and Oil	522	Honey, Adulterated	179
Lamps, Incandescent	421	Substitute for	153
Lamps, Regenerative	595	Hop Bitters	211
Liquor	655	Hopene	173, 171, 218
Made from Tar	5	Hops, Alkaloid of	173, 174
Making, Pitch employed in	522	Hops saved in Brewing	453
Manufacture	421	Treatment of	515
Manufacture from Oil	160	Hosiery Dyeing, Use of Antimony Mordants in	301
Producer	317, 522	Relation of Dyed, to Skin Irritation	226
Producers	421	Hydrastine	677
Purification, Ammonia Process (illus.)	415	Hydraulic Mains, Gas	317
Purification by Oxide of Iron	426	Hydrazinido-compounds	28
Regulator, Non-metallic (illus.)	175, 176	Hydrocarbons in Coal Gas	653
Residuals, Utilisation of	426	Combustion of, and Gas from	118
Retorts	235, 236	Employed in Alkali Process	379
Retorts for	318	Employed as Fuel	373
Statistics of Production	560	Enrichment of Coal Gas by	2
Water	471	Furnaces heated by	236
Gases, Ammonia from	235	Gas from	522
Apparatus for Absorption of	468	Purification of	419
Apparatus for Absorption by Liquids	423	Recovered from Aromatic Sulpho-Acids	317
Cooler for (illus.)	325	Hydrochloric Acid, Action on Nitrosodimethylaniline	597
In Hot Spring of Leuk	505	Acid detected in Vinegar	509
Regenerating Waste	160	Acid freed from Arsenic	602
Scrubber or Cleanser for	317	Acid from Chloride of Calcium	32
Specific Heats at High Temperatures	11	Acid, Purification of	531
Gaseous Fuel, Iron Manufacture with	212	Hydrocyanic Acid, Detection of	679
Gasoline, Vapour Tension of	3	Hydrofluoric Acid, Glass Etched by (illus.)	669
Gasometric Assaying (illus.)	115	Hydrogen Batteries	675
Gelatine Test for Water (illus.)	114	And Carbonic Oxide, Combustion of	370
Gelatins	381	Influence of Aqueous Vapour on Oxidation of	211
Germination of Peas and Wheat	385	Manufacture	160
Gilding, Alloy for Mercurial	35	Peroxide employed in Analysis	331
Glass	536	Peroxide, Estimation of	391
Glasgow Section, Chairman's Address to	390	Peroxide from Oxidation of Turpentine	9
Glass, Coloured or Opalescent	491	Peroxide used with Gas Referees' Sulphur Test	285
The Etching of (illus.)	669	Peroxide, Valuation of Chloride of Lime by	391
Gilding	536	Preparation of	391
Furnaces	100	Reaction with Carbonic Acid	24
Ornamental Designs on	99, 100	Hydroquinone. See Quinol	161
For Standard Thermometers	167	Hydroxyanthranol (Beta)	95
Transparent Paper as Substitute for	456	Hydroxystearic Acid	452
Vessels with Wire inserted	536	Hydroxythionaphthen	418, 119
Glazing Porcelain, etc.	491		

	PAGE		PAGE
Hypnone	388	Kaolin, Analyses of	189
Hyposulphates, Alkaline	324	Ultramarine from Japanese	166
Hypoxanthin	385	Kerosene, Examination of	176
		Ketones, Ammonia as Reagent for Double	180
Ice-making Machinery (illus.)	133, 158	Aromatic	321
Manufacture	22, 24, 124	Sulphonated Rosaniline a Test for	287
Incandescent Electric Lamps	514	Kiln for Cement	100
Gas Lamps	421	Cement	605
Gas Lamps, Material for	522		
Incrustation prevented in Boilers	454	Lactalbunin	387
Indiarubber	432	Lactate of Antimony as a Mordant	183
Commercial	211	Lactic Acid Manufacture	677
Dissolving Vulcanised	195	Acid used in Beverages	616
Plants, Fibre of German	182	Lactoglobulin	387
Soft Vulcanised	242	Lactucarius Plants, Utilisation of	195
Substitutes for	214	Lamp Oils, Comparison of	311
Tube	103	Lamps, Electric	615
Vulcanised	638	Mineral Oil	109
Indicator, Congo Red as an	73, 679	Lanolin	578, 671, 672
Indicators for Acids	392	Lanthanum Salts, Purification of	522
Alkalimetric	219, 437	Laundry Blue	523
Methyl-orange	287	Lead, Action of Oils on	363
For Sulphurous Acid	517	Autogenous Soldering of	431
Indigo, Substitutes for	661	Bin oxide used for Freeing Alum Cake from Iron	21
Indigo-blue, discharge on	182	Detection of Traces in Water	84
Indoanilines	28	Ores, Pigments from Waste	432
Indophenols	28	Sampling Zinc containing	537
Ink from Waste Dye-liquors	127	Steel Pots for	167
Inks, Marking	30	White	329, 539
Writing	30	White, Japanese Method of making	312
Insecticide	102	White, Manufacture	325
Institute at Zurich, Cost of	577	White, Substitute for	109
Insulating Compound	65	Leather, Artificial	133, 195, 496
Material	172, 609	Black Varnish for	609
Iodide Bath for Silvering	246	Dressing, Substitute for Urine in	496
Method of Copper Determination	51	Elastic	452
Iodine Absorptions of Oils	68, 282	Scrap prepared as Manure	104
Absorption Test for Oils	308	Treatment of	329
Colourless Solution of	332	Waste, Utilisation of	329
In Candles	199	Levulose, Action of Dilute Acids on	673
Solutions, Standardising	391	An Ether of	433
Test for Peppermint Oil	179	Oxidation of	170
Used with Gas Referees' Sulphur Test	281	Leys used in Fireless Steam Generators, Regeneration of	
Iodoform, Action of Light on	172	(illus.)	158
Aromatised	218	Lignite Clay as a Filtering Medium	105
Powder	501	Lime, Action on Metals	493
Iron, Action of Oils on	303	Chloride, See Bleaching Powder	73
Alizarates	523	Chloride, Ores acted on by	431
Aluminium Alloy of	329	Chloride, Valuation of	391
Cast, Strength of	289	Kilns	328
Chemistry of Foundry	289	Limit of Action on Sodium Carbonate	240
Chrome	605	Milk of	423
Coated with Tin, Lead or Zinc	452	Phosphate, Treatment of	696
Colour Test for Carbon in (illus.)	586	And Soda Method of Purifying Water (illus.)	267
Determination of Manganese in	508	Solubility of	450
Determination of Phosphorus in	176, 507, 569	From Sugar-works, Treatment of	671
Phosphide	104	Sulphate from Copper and Chlorine Residuals	536
Phosphide in Basic Slag	451	Treatment of Sewage with	451
Pigments from Copper Waste Liquor	536	Water	450
Puddled	382	Waters, Influence in Wool-dyeing	520
Removal of Metalloids from	605	Leaves, Oil of	436
Separated from Alum Cake	20	Liquids, Separation of Vapours from (illus.)	468
Separated from Aluminium	41	Liquorice in Beer detected	508
Silicon in	606	Lithographic Stones, Substitute for	49
And Steel direct from Ores	494	Liverpool Section, Chairman's Address to	565
And Steel, State of Carbon in	493	Lobelia Alkaloids	501
Sulphate used in Agriculture	433	Locomotives, Oil Burners for (illus.)	475
Tannate used in Filters	418	Logwood faced with Magenta	286
Toughened Cast	292	Lokain	162
Treatment of Spent Oxide	32	Lokanic Acid	162
Treatment of Waste Galvanised	451	Lokao	162
Wire Gauze, Waterproofed	671	Lokaonic Acid	162
Coke Filters for Water	265	Lubricant	102
Stone Carbonised for Filtering Purposes	675	Lubricating Compounds	609
Determination in presence of Alumina	507	Materials	329
Determination of Silicon in	502	Oils from Petroleum Residues (illus.)	382
Estimated in Phosphates	152	Value of Oils (illus.)	121
Estimation of Phosphorus in	106	Lupines, Treatment of	169
Estimated in presence of Phosphoric Acid	176, 219	Lupulin, Acids in Commercial	545
Extraction of Phosphorus from German	102		
Influence on Plants	610	Magdala Red	480
Malleable, direct from Ore	198	Magenta, Archil and Logwood adulterated with	286
Manufacture	101	Bases of	318
Manufacture with Gaseous Fuel	212	Manufacture (illus.)	163
"Mitis" Castings	209	Magentas, Detection of	334
Mixtures of Pig.	290	Reaction for Sulphonated	178
Ore, Gas Furnace for	608	Magnesia in Cement, Influence of	492
Ore, Pigments from	35	Crucibles, etc.	382
Ores, Arsenic determined in	547	Cupels made of	558
Ores, Treatment of	328	Used in Ammonia-soda Process, (illus.)	183, 487
Oxide, Manufacture	240	Waters, Influence in Wool-dyeing	530
Oxide, Purification of Gas by	426	Magnesium Chloride Manufacture	33
Isatin, Paramethyl, Derivatives of	237	Manufacture	31
Isinglass from Seaweed purified by Freezing	112	Sulphhydrate, Pure Sulphuretted Hydrogen from	240
Isoallylthylene	371	Maize, etc., Syrup and Beer from	153
Isobenzidine	347	Majolica Ware, Imitation	31
Isohesperidin	380	Maleic Acid, Inactive Maleic Acid from	240
Isohexane, Action of Heat on	373	Maleic Acid	240
Isovaleraldehyde, Condensation with Aniline	162	Malting	104
		Maltose	213
Japanese Kaolin, Ultramarine from	166	Manehoster Jubilee Exhibition	637
Jubilee Exhibition, Manchester	637	Section, Chairman's Address to	576
Kairin	581, 676	Yellow detected in Saffron	437

	PAGE		PAGE
Manganese Alloys	431	Mordant, Antimony Oxalate as a	239
Binoxide used for freeing Alum Cake from Iron	21	Chrysamin as a	532
Brown, Action of Aromatic Bases on	182	On Cotton, Antimonious Chloride as a	590
Determination	391	Potassium Antimony Oxalate as a	165
Determination in Iron	508	Mordanting Wool	526
Estimation	249, 365	Mordants	165, 183
Influence on Iron	291	Chocolate, Removal of Gum from	596
Voltaic Batteries	675	Morphine	391
Volumetric Test for	122, 167	Reactions for	509, 618
Manure, Basic Slag prepared as	433	Mortar Mill	100
Loss of Ammonia prevented by Gypsum	611	Mucilage from Cotton-seed Oil, Utilisation of	201
Phosphate Slag as a	161	Muffles	382
Phosphoric Acid used with	672	Mural Decoration, Composition for	603
Slag as a	330		
Stable	541	Naphthalene Colours	602
Value of Slag as a	101, 101, 212	Naphthalene-tetracarboxylic Acid	595
Manures, Estimation of Alumina and Iron in	152	Naphthas, Treatment of Spent Acids from Purification of	160
Testing Artificial	540	Naphthidine	238
Manurial Value of Basic Cinder	610	Naphthionic Acid	161, 376, 449
Manuring Experiments with Phosphates	100, 327	Naphthol as a test for Nitric Acid	157
Marble Imitation	511	Naphthols, Azo-dyes from	127, 428
Marsh-land, Experiments on	511	Naphthol-Alpha Sulphonic Acid (Beta)	29
Measure for Equal Quantities of (illus.)	235	Beta-Sulphonic Acid (Alpha)	28
Measurer for Liquid Carbonic Acid (illus.)	326	Naphtholcarbonates, Alkaline	482
Measures, Glass, with Strips of Opal Glass	652	Naphtholdisulphonic Acid	373
Meat Preparations, Analyses of	37	Acid, Colours from	164
Preservation of	57	Naphtholmonosulphonic Acid, Colours from	161
Medicines, Saccharine compounded with	677	Naphtholparadiazodiphenylsulphonic Acid	376
Medlar, Japanese	218	Naphtholtrisulphonic Acid	378
Meeting, Report of Fifth Annual	400	Naphthylamine, Action on Manganese Brown	482
Melittose from Cotton Seed, etc.	213	Beta, Azo-compounds of	28
From Molasses, etc.	386	Beta-, Action of Diazo-compounds on	26
Present in Beet	169	Dinitro-	597
In Sugar Products	101	Naphthylaminesulphonic Acid	449
Melting (of a Solid, Heat absorbed in the	111	Acids	376
Points, Determination (illus.)	617	Acids, Isomeric	161
Mentha Pip. and Vir., Comparison of Oils of	173	Beta-, Acid	481
Menthol Derivatives	156	Naphthylenediamine (Alpha-Beta-), Action of Diazo-compounds on	26
Menthylurethane	156	Naphthylenetoluquinoxaline	378
Menthylbenzoate	156	Naphthylhydrazines	374
Carbonate	156	Narcotics, Identification of	335
Phthalate	156	Newcastle Section, Chairman's Address to	584
Succinate	156	Nickel-coated Copper Plates	331
Mercurous Iodide, Solubility in Fats, etc.	218	Nickel and Cobalt Separation	618
Sulphate, Stability of	499	Distinguishing Coating of	619
Tannate	218	Manufacture	172
Mercury from Zinc-blende	534	On Plated Goods, Determination of	503
Biodide incorporated with Soap	600	Nicotine, Reduction	40
Electrodes, Cells with	500	Nitranilines, Diazoised	523
Mesitylene in Petroleum	25	From Nitrophenols	450
Metacresol	237	Nitrates, Nitrogen Determination in	510
Metal Plates, Pickling	191	Nitration of Dimethylaniline	376
Protecting Compound for	152	Nitrazobenzene	598
Metals, Action of Lime on	193	Nitric Acid Determination	617
Action of Oils on	362	Acid, Fire caused by	379
Action of Soda on	581	Acid, Naphthol as a Test for	457
Alloyed with Sulphides	34	Acid, Purification of	31
Detected in Drinking Water	81	Oxide, Degree of Solubility in Sulphuric Acid	82
Electrolytic Reduction of	331	Nitrification in Soil	510
Electrolytic Separation of	216	Nitrocellulose, Artificial Leather, etc., made from	35
Electrolytic Treatment of	151	Nitrometer, Alleged Error in Using	82
Galvanising or Coating	101	Application of (illus.)	505, 677
Manipulated by Electric Arc	675	Nitrogen in Coal, Determination (illus.)	506
Production of Alkali	601	Determination (illus.)	179, 180, 507, 510, 550, 510, 617
Separation by Electrolysis	675	Fixed by Soils	103
Separated from their Ores	101	Obtained from Air	40
Metallic Etching	102	Separated from Sulphuretted Hydrogen	33
Metallised Woven Fabrics	288	Nitrogenous (constituents of the Soil	169
Metalloids removed from Iron in Basic Furnace	605	Nitrophenols, Nitranilines from	450
Metaxylenol	257	Nitrosodimethylaniline, Action of Hydrochloric Acid on	597
Phenylazo-	318	Nitrothiokol	419
Methyl Alcohol in Plants	317	Nitrous Acid, Estimation	633
Methylanthragallol	399	Acid, Oxidation of	287
Methylene Blue	598	Njimo Wood	501
Methyl-orange not available as Indicator with Nitrites	287		
Methyl-violet, Bases of	318	Obituary, H. Sugden Evans	157
Formation with Perchloromethylmercaptan	320	James Muspratt	314
Methoxyl, Determination of	335	William Ripley Nichols	519
Mexican Customs Tariff	681	Oil, Adulterations in Olive	168
Micro-organisms in Drinking Water	511	Burners (illus.)	174
Microphytes in Potable Water	114	Examination of	494
Mildew on Vines, Copper Sulphate used to Destroy	169	Extraction of	102
Milk, Albumenoids of Cows	387	Gas	171
Analysis	546, 613, 618	Gas from	522
Determination of Butter in	198	Gas, Hydrocarbons from	374
Evaporated	613	Gas Manufacture	160
Pasteurised	198	Oxidised for Protecting Wire, etc.	432
Purifier	37	Oils, Action on Metals	362
Sugar, Decomposition by Hydrochloric Acid	672	For Batching Wool	383
Sugar Constituents in Plants	386	Containing Unsaponifiable Fats	179
Mineral Oil detected in Fat Oils	176	Detection of Mineral Oils in Fat	176
Oil Lamps	169	Examination of	503
Oil, Still for	376	Examination of Fixed (illus.)	65, 282
Oils estimated in Fats	157	Extracted from Waste	452
Oils, Removal of Waste Acid in Purification of	160	Fragrant Essential	436
Statistics, Prussian	682	Increasing Viscosity of	608
Mint, Detection of Turpentine in Oil of	171	Lubricating, Refining	494
Oil of	173	Lubricating, "Thickener" for	539
"Mitis" Iron Castings	209	Maumene's Test for	150, 361
Molasses, Raffinose from	386	Mineral, Gas Furnaces for Distilling	594
Raffinose in	104	Oxidation of	494
Separation of Sugar from	612	Refining	452
Treatment of	213		
Monomethylanilinefurfuraniline	377		

	PAGE		PAGE
Oils, Testing Mineral.....	616	Phenylcarbinol, Hexamethyltriimidetri.....	318
Valuation of Lubricating (illus.).....	121, 118	Phenolhydrazine, By-product of.....	237
Viscosity of (illus.).....	359	Colours from.....	127
Oleic Acid, Action of Sulphuric Acid on.....	452	Phloroglucinol.....	377
Oleic Acid, Valuation of.....	73	Phosphate, Decomposition of Redonda.....	570
Olive Oil, Adulterations in.....	168	Slag as a Manure.....	461
Oil, Examination of.....	303	Phosphates, Action of Potassium Sulphate on.....	483
Oil, The Elaidin Reaction for.....	539	Phosphates, Alkaline, from Slag.....	325
Opianic Acid, Azo.....	319	Estimation of Alumina and Iron in.....	152
Orange, Kind of Bitter.....	390	Manufacture.....	433
Orcinol, Action of Aniline on.....	539	Manuring Experiments with.....	541
From Acetone-dicarboxylic Ether.....	481	Prepared for Treatment of Sewage.....	451
Beta-, Derivatives of.....	599	From Slags.....	379, 537
Ores, Dressing and Separating.....	35	Values of.....	572
Electrolytic Treatment of.....	451	Phosphoretic Slag, Treatment of.....	672
Grinder for.....	491	Phosphoric Acid Determination.....	176, 391, 392, 502, 510, 510
Reduction of.....	101	Acid, Estimation of Iron and Aluminium in presence of.....	219
Steel and Iron direct from.....	491	Acid, Iron and Alumina detected in presence of.....	176
Treated in Gas Furnaces.....	126	Acid as a Manure.....	101
Treatment of.....	167, 328, 607	Acid, Purification of.....	669
Treatment of Antiferrous.....	491	Acid used with Manure.....	672
Treatment with Sulphuric Acid.....	537	Anhydride.....	545
Washing.....	431	Phosphorite Deposits in Tunis.....	169
Organic Analysis (illus.).....	333	Phosphorus, Determination of.....	176
Orpiment, Commercial.....	495	Determination in Iron and Steel.....	507, 509
Orthite, Treatment of.....	522	Estimation in Iron.....	106
Oven for Laboratories.....	106	Influence on Iron.....	291
Oxalic Acid, Formation in Vegetation.....	541	Phosphuretted Hydrogen as Igniter with Gas Engines.....	171
Oxycellulose, Properties of.....	546	Photographic Paper, Sensitive.....	97
Oxydimorphine.....	617	Photometric Value of Petroleum.....	371, 480
Oxygen in Coal, Influence of Amount on Products.....	653	Photosantonin Acid.....	40
Obtained from Air.....	40	Photosantonin.....	40
Purification of Water by.....	650	Photo-telegraphy.....	216
Oxygenated Liquids.....	105	Phthalic Acids, Constitution of.....	27
Water.....	128, 653	Anhydride, Dibromhydroxymethyl.....	30
Oxyphenyltolylamine.....	161	Phylloxera, Alkali Waste employed to Destroy.....	169
Oxyquinoline-carbonates.....	616	In Vines, Destruction of Ova.....	496
Oxythionaphthene.....	481	Physiological Action of Food.....	613
Ozokerit, Waterproof Material from.....	35	Picoline (Beta-),.....	95
Ozone, Purification of Water by (illus.).....	650	Picolines, Alpha- and Gamma-.....	236
		Picric Acid as an Explosive.....	679
		Pigment, White.....	559
		Pigments.....	103, 609
Paints.....	384	From Antimonial Ores.....	523
Palladium Alloys.....	452	From Copper and Chlorine Residuals.....	536
Pancastite.....	199	From Slag.....	102
Pancreas used for Removal of Gummy Matter.....	428	From Waste Lead Ores.....	432
Papaine, Action of.....	390	Pimaric Acid.....	25
Paper for Indelible Writing.....	331	Piperidine from Pentamethylene Diamine.....	106
Making Material, Wood as a.....	273	Pitch used in Gas-making.....	522
Making from Wood.....	349	Plants, Formation of Oxalic Acid in.....	511
Manufacture.....	332	Galaetose in.....	386
Pulp, Boilers for.....	676	Influence of Iron on.....	610
Pulp, Manufacture.....	321, 435	Methyl Alcohol in.....	317
Pulp, Waste Products prepared as Fodder.....	435	Plaster, Manufacture.....	451
Rendered Transparent.....	456	Plated Metals, Distinguishing.....	619
Sizing.....	331	Platinised Carbon Filters.....	105
Stained by Woollen Goods.....	637	Poenta Moutan, Constituent of Root of.....	456
Transparent Photographic.....	97	Poisoning by Atropine.....	332
Paraffins, Action of Heat on.....	373	Porcelain, Glaze for.....	491
Paramethylisatoic Acid.....	237	Mixtures for.....	489
Paraquinasol.....	248	Seeger.....	211
Paratoluidine, Action on Resorcinol and Quinol.....	161	Vessels with Wire inserted.....	536
Determination of.....	178	Potash, Action on Resins.....	221
Paraxyloquinoline.....	239	Carbonate, Manufacture.....	33
Parvoline, Synthesis of.....	96	Caustic, Manufacture.....	31
Pasteurised Wine.....	211	Chlorate, Manufacture.....	108
Peas, Oxidation of Sulphur in Germination of.....	385	Potassium Anhydrometabisulphite, for Browning.....	170
Peat Charcoal.....	612	Carbonate.....	428
Fibre, Washing and Cleansing.....	172	Chloride, Sodium Chloride Determined in Presence of.....	40
Pencils, Inks for.....	30	Manufacture.....	538
Pentamethylenediamine, Piperidine from.....	106	Pernanganate as Reagent for Alkaloids.....	510
Pentane, Action of Heat on.....	374	Sulphate, Action on Phosphates.....	483
Peonol.....	456	Sulphate, Manufacture.....	211
Peppermint, Oil of.....	173	Prehnitene.....	375
Oil, Iodine Test for.....	179	Premitic Acid.....	375
Pepsin.....	151	Pseudocumene in Petroleum.....	25
Gummy Matter removed from Fibre by.....	128	Pseudocumensulphonie Acid.....	375
Treatment of Vegetable Fibres with.....	161	Pseudocumene, Derivatives.....	26
Peptone Analysis.....	617	Pseudomorphine.....	616
Albumen separated from.....	543	Pumps for Refrigerators (illus.).....	133
Perchloromethylene and Aniline Compounds.....	320	Purpurin, Synthesis.....	319
Colours formed by means of.....	96	Putrefaction, Influence of Thalline Salts on.....	431
Perchloronaphthalene.....	378	Puzzolana Cement.....	211
Perfumes, Extraction of (illus.).....	136	Pyrene.....	119, 585
Petroleum, Baku.....	661	Pyrenic Acid.....	419
Comparison between American and Caucasian.....	177, 480	Pyridine prepared from Pyrroline.....	236
As an Illuminating Agent (illus.).....	371	Pyrites, Arsenic in Spanish.....	296
Oil of Baku (illus.).....	172, 180	Assay of Cupreous.....	50
Pseudocumene and Mesitylene in.....	25	Determination of Sulphur in.....	156
Residues, Burners for (illus.).....	174	Extraction of Zinc from Burnt.....	101
Residues, Lubricating Oils from (illus.).....	382	Furnaces for Smelting.....	168
Valuation (illus.).....	654	Silver estimated in Burnt.....	548
Phenanthrenenaphthaquinoline.....	26	Of South Hungary, Sulphuric Acid from.....	378
Phenazine.....	661	Statistics of.....	97, 101
Phenol, Mononitro.....	160	Sulphuric Acid from.....	324
Phenol Colouring Matter, Liebermann's.....	238	Treatment of Cupreous.....	403
Determined in Crude Carbolic Acid.....	516	Pyritous Ore, Treatment of.....	382
Determined as Tribromophenol.....	376	Pyrometer.....	23
Phenolparadiazodiphenylsulphonie Acid.....	215	Hot Blast (illus.).....	631
Phenolphthalein as Indicator.....	501	Pyrometers (illus.).....	236
Phenolsalicylate.....	501		
Phenylsaffranine.....	538		
Phenylazoacetophenone.....	26		
Phenylazobenzoylactic Acid.....	26		
		Quartz, Grinding Machine for.....	158

	PAGE		PAGE
Quercitron, Dyeing with	528	Silicates, Manufacture of Alkaline	33, 167
Quinaldine, By-products of	258	Silicon in Foundry Iron	666
Synthesis of	161	Influence on Iron	291
Quinine Bark, Official	388	In Iron, Determination of	502
Hydrate	501	Silk Cocoons, Treatment of	322
Sulphate	501	Cotton	612
Quinol, Action of Paratoluidine on	161	Dressing, Treatment of Liquors from	378
Quinoline, Paraxylo-	239	Size for	432
A Phenyl-	161	Silver Chromate, Solubility in Ammonium Nitrate	286
Raffinose in Barley	36	Silver, Distinguishing Coating of	619
From Molasses, etc.	386	Estimated in Burnt Pyrites	548
Present in Beet	169	Silvering, Iodide Bath for	246
Present in Sugar Products	104	Size	672
Ragasin	661	For Raw Silk	432
Rags, Waste, etc., Treatment of	322	Skin Irritation not caused by Dyes	301
Rape Oil, Examination of	303	Irritation, Relation of Dyed Hosiery to	226
Red Colours, Discrimination of	250	Slag, Action of Carbonic Acid on the Thomas-	381
Red Liquor, Valuation of	73	Cement	603
Red, Magdala	480	Cement from	241
Refrigerators	22, 21	Composition of Basic	606
Refrigerators (illus.)	133, 158	Determination of Phosphoric Acid in	392, 502
Resin-acid Ethers for Varnishes	523	Influence of Frost on Cement mixed with	492
Resin Oil detected in Fat Oils	176	Iron Phosphide in Basic	451
Resinous Compounds, Hardening	103	As a Manure	101, 101, 330, 433
Resins, Action of Potash on	221	Phosphatic, as a Manure	161
Bleaching and Refining	539	Rich Phosphates from	537
Manufacture of Turpentine from	318	From the Thomas process	242
Reactions of	168	The Thomas	329
Resorcin Blue	662	Treatment of	452, 492
Resorcinol, Action of Paratoluidine on	161	Treatment of Sewage with Phosphoric	245
Reactions for	580	Utilisation of	387
Resorcinolparadiazodiphenylsulphonic Acid	376	Utilisation of the Thomas	385
Retort Furnaces Fired with Tar	125	Utilisation and Treatment of	672
Rhamnus, Colouring Matter from	162	Slags, Alkaline Phosphates from	379
Rhea Fibre	76	Slate Rubbish, Utilisation of	100
Rhea Fibres, Treatment of	450	Smoke Condensed by Electricity	172
Rivers, Pollution of	498	Electrical Deposition of (illus.)	572
Purification Bill, Rejection of	157	Soap, Ammoniated	329
Rosaniline, Chlorine Derivatives of	397	Antiseptic	609
Employed in Testing for Ketones	287	Disinfectant	102
Salts, Detection of	287	Liquid	452
Rosanilines, Reaction for Sulphonated	178	Manufacture	495, 671
Rosin determined in Soaps	392	Paste for Wool, etc.	329
Spirit	10	Solutions, Viscosity of	91
Spirit, Cymene in	595	Toilet	608
Treated with Oxide of Zinc	432	Soaps, Action of Chloride of Sodium on Solutions	90
Rubber, Vulcanised	35	Determination of Rosin	392
Vulcanising	101	Soap-suds, Utilisation of	102
Saccharate of Lime	453	Soda, Action on Metals	381
Saccharine	349, 350, 421	Ammonia Process (illus.)	533
Admixture with Medicines	677	Ammonia Process, Chlorine from By-products	451
As an Antiseptic	616	Bicarbonate, Manufacture	325
Detected in Sugar	546	Bichromate, Manufacture	33
Influence on Sugar Industry	612	Carbonate direct from Sulphate	613
A Sweetening Agent from Coal Tar	75	Carbonate, Manufacture (illus.)	166, 668
Saccharimeter, Portable (illus.)	8	Caustic, Manufacture	31
Saccharomyces Mycoderma, Action on Citric Acid	216	Crystals (Ammonia Process)	138
Safranin	398	Drums for Caustic	666
Magdala-red as a	480	History of Solid Caustic	283
Safranines	319	And Lime Method of Purifying Water (illus.)	267
Saffron, Detection of Manchester-yellow in	137	Liquor, Filters for	424
Sake (Japanese Beer)	170	Magnesia used in connection with Ammonia Process	183
Salicylic Acid, Detection	618	(illus.)	487
Acid, Manufacture	501	Manufacture, Improvements in	407
Acid, Paramethyl-	237	Metallic Drums for, etc.	424
Salicylphenylether (Salol)	577, 580	Nitrate, Extraction of	326
Salol	501, 677	Origin of Ammonia Process	322
Manufacture of	577	Titration in presence of Alumina	679
Salts, Specific Gravities of	601	Treatment of Bicarbonate	210
Value of Inorganic, as Food	613	White Caustic	351
Sampling Viscid Liquids (illus.)	211	Sodium Bicarbonate (illus.)	129
Sand, Influence on Cement	194	Carbonate, Limit of Action of Lime on	240
Sand-iron Ore, Paint made with	35	Chloride, Action on Soap Solutions	90
"Sanitas," Fluid and Oil	8	Chloride, Decomposition of Phosphate by	571
Santonin, Constitution and Derivatives of	40	Chloride Determined in presence of Potassium (chloride 10	239, 241
Saponaceous Material	284	Chromate	538
Saponification of Oils, etc.	131, 132	Manufacture	571
Test for Oils	309	Nitrate, Decomposition of Phosphate by	571
Schools and Dwellings, Air of	513	Sulphides, Hydrated	534
Schweinfurt-green	596	Thiosulphate for Clarifying Syrups	169
Scrubber or Washer for Gases	423	Soil, Nitrifying Organisms in	540
Sea-water, Amount of Bromine in	40	Nitrogen in the	169
Evaporator for	521	Soils, Fixation of Nitrogen by	103
Seaweed, Isinglass from, Purified by Freezing	142	Soldering	131
Selenides from the Andes, Analyses of	34	Solutions, Specific Gravities of	601
Selenium Cell applied to Photo-telegraphy	246	Sparteine	545
Separator for Substances of different sizes	94	Specific Gravities of Salts	601
Sesame Oil, Examination of	303	Gravity, Continuous Apparatus for	95
Settling Tank for Impure Water	368	Gravity of Fats, etc.	67, 71
Sewage, Cement made from	451	Spent Oxide Reoxidised without Removal	426
Chemical Treatment of	311	Oxide, Treatment of	32
Influence of, on Fish	214	Spindles, Pressure on	123
Purification of	38, 39, 611, 615	Spirit, Formation of Bad Crude	330
Treatment of	103, 171, 245, 246, 387, 451, 499, 671, 675	Spirits, Maturing	134
Shade Oil, Still for	376	Spreader for Liquids (illus.)	143
Sheep-wash	102	Standard Solution of Tartar Emetic, Preservation of	464
Shellac Algin	221	Starch, Examination of	72
Ship Sheathing	85	Manufacture	330
Ships' Bottoms, Anti-fouling Composition for	329	Paste, Determining Stiffness of	143
Composition for	35, 102, 195	Sugar, Honey Adulterated with	179
"Sig." Substitute for	496	In Tobacco Leaves	169
Silicates Decomposed by Alkaline Carbonates	117	Treatment of Waste Liquor	612

	PAGE		PAGE
Steam Blast, Cupola with	451	Sulphurous Acid from Zinc Blende	531
Boilers, Purification of Water for	158	Ores, Calciner for	428
Generators, Fireless (illus.)	158	Sylvic Acid	25
Spray, Apparatus for Tar, etc. (illus.)	471	Syphon (illus.)	141
Steaming, Influence on Fastness of Colours	532	Syringe for Sampling Viscid Liquids (illus.)	211
Steel, Bessemer	607	Syrup from Maize, etc.	453
Change of Texture on Heating and Cooling	538		
Chrome	605	Tank Liquors, Purification	325
Determination of Phosphorus in	176, 507, 509	Tannate of Mercury	218
Estimation of Phosphorus in	106	Tannin Determination	549
Direct from Ore	168	Estimation	179, 210
And Iron direct from Ores	494	Extracts, Examination of	495
Malleable Cast	607	Extracts, Treatment of	384
Manufacture	101, 328, 329, 382, 431	Tanning	423, 510, 609, 672
Progress of Basic Process	683	Tannins, Estimation of	79
Rails, Durability of	493	Tar and Coke mixed as Fuel for Gas Generators	471
Scrap added to Cast Iron	294	Composition and Value of	425
Still for Alcohol, etc.	613	Furnace for Burning	561
For Ammonia (illus.)	667	Gas made from	5
For Fragrant Essential Oils (illus.)	426	Products from	426
For Glycerine	329	Retort Furnaces fired with	425
For Shale Oil	376	Steam-spray, Apparatus for (illus.)	471
Stills for Petroleum (illus.)	473	Tariff Changes	681
Stirrer, Earthenware Disc used as	86	Tartaric Acid, Determination	497
Stone, Artificial	100, 327, 381, 451, 603	Acid with Tin Mordants	627
Glazed	381	Tartar Emetic, Preservation of Standard Solutions	464
Preserving	101	Emetic, Valuation of	71
Strainer for Tannin Determinations	82	Tartrazine (a Yellow Dye)	427
Straw, etc., Treatment for Paper	321	Tawing Hides	133
Strings, Gut	384	Tea, Theine determined in	178
Strontium Carbonate, Decarbonation of	163, 324	Technical Education	565, 585
Chloride and Hydrate	430	Temperature Regulator (illus.)	501
Hydrate	379	Terpene from Oil of Turpentine, Active	474
Hydrate, Manufacture	639	Tetrachloronaphthalene	378
Purification of Hydrate	33	Tetramethylbenzene	375
Saccharate Process	243	Tetrazo Colours	96
Strychnine, Sulphonic Acids of	174	Thalline	218
Subsidence, Apparatus (illus.)	653	Salts, Influence on Putrefaction	431
Sucrose and Glucose, Average Percentages in Sugar		Sulphate or Tartrate, Test for	580
Cane	117	Synthesis	515
Sugar	612	Thallium Sulphuricum	332
Beet	213	In Commercial Zinc	493
Cane, Percentage of Juice in	453	Theine determined in Tea	178
Detection of "Saccharine" in	516	Thermograph	316
Determination of Invert	517	Thermometer, Air (illus.)	509
Extraction and Treatment of	330	For High Temperatures (illus.)	634
Grape	530	Thermometers	652
Invert	612	Glass for Standards	167
Liquor, Filter for	674	Metallic	234
Manufacture	453	Registering	316
Products, Analysis of (illus.)	170, 286	Thermo-Regulator (illus.)	504
Refining	453, 632	Thermostat (illus.)	175, 176, 519
Senn, Utilisation of	453	Thienyldisulphide	449
Solutions, Clarification of	169	Thienylmercaptan	449
Solution, Treatment of	104	Thio-bases of Diamines, Colours from Oxidation of	161
Statistics	681	Thionaphthen	418
In Tobacco Leaves	169	Thioparatohydride, Colours from	96
Treatment of Spent Lime from	674	Thiophen, Constitution of	160
Works, Composition of Tank settlements	542	Influence on Reactions of Benzene	180
Sugars, Action of Dilute Acids on	673	Mercaptan of	481
Of some of the Cereals	36	Thiophenol	113, 181
Sulphides alloyed with Metals	31	Thiotenol	449
Electrolytic Treatment of	99	Thioxen, Isomeric	480
Eliminated from Vat-liquors	32	Thomas-slag, Grinding	212
Used in Galvanic Batteries	172	Tiles, Enamelled	31
Sulphites, Manufacture	31, 99	Timber, Preservation of	431, 670
Sulpho-Acids, Recovery of Hydrocarbons from Aromatic	317	Tin, Action of Oils on	363
Sulphocyanides	379	Coating Metals with	152
Manufacture	324	Distinguishing Coating of	619
Sulphur from Alkali Waste	536	Mordants	526
In Candles, etc.	99	Plate Manufacture	241, 242
Chlorides	638	Plates, Manufacture of	191
In Coal and Coke, Condition of	521	Scraps, Treatment of	545
In Coal Gas, Estimation (illus.)	283	Scrap, Utilisation of	493
Dioxide used with Carbon Dioxide in Ice Machines	139	Slimes, Treatment of	328
Estimation in Coal and Coke	154	Utilisation of Waste	538
Influence on Iron	291	Timing	101
Oxidation in Peas	385	Tobacco Leaves, Starch and Sugar in	169
Production of	666	Toluene, "Saccharine" made from	75
Recovered from Spent Oxide, etc.	32	Toluidines	481
From Sulphuretted Hydrogen	99	Tolylenediaminedifurfuraniline	377
Sulphuretted Hydrogen free from Arsenic	40	Tolylene Red	661
Hydrogen, Making Pure	240	Torpedoes, Electric Fuses for	679
Hydrogen Manufacture	668	Tonloquamine	390
Hydrogen, Separation of Nitrogen from	33	Trade Statistics	682
Hydrogen from Sulphide of Ammonium	33	Transfers, Varnish for	609
Sulphuric Acid, Action on Oils	450	Transpirometers for Oils (illus.)	360
Acid in Alum Cake, Free	617	Tribenzylamine, Action of Sodium on	377
Acid Concentrated by Crystallisation	356	Trichloronaphthalene	378
Acid detected in Vinegar	509	Trigonelline	217
Acid, Employment of Arsenical	671	Trimesic Acid	377
Acid from Gypsum	489	Triphenylmethane, Synthesis of	482
Acid Manufacture (illus.)	668, 666	Tungstic Acid, Titration of Soda in presence of	679
Acid Manufacture, Chemistry of	106	Turkey-red Dyeing, Influence of Bleaching on	239
Acid Manufacture in Hungary	378	Dyeing, Theory of	662
Acid from Pyrites	324	Turmeric as Indicator for Citric Acid	211
Acid, Solubility of Nitric Oxide in	203	Turpentine, Active Terpene from Oil of	171
Acid Test for Oils	203	Detected in Oil of Mint	171
Acid Tower	326	Manufacture	318
Acid, Treatment of Ores with	357	Oil, Detection of	393
Sulphurous Acid employed in Felting	378	Oxidation of Russian	7
Acid, Indicators for	547	Substitute for	522
Acid Manufacture	99	Viscosity of	149
Acid, Vapour Tension of	131	Tuyeres for Pyrites Furnaces	168

	PAGE		PAGE
Ultramarine	523	Water Closets in Dwellings	614
From Japanese Kaolin	466	Pipes, Tarred Cast-iron	37
By Wet Method	238	Waters, Corrosion of Copper and Brass by Saline	84
Umbelliferone	446	Waterproof Fabrics	164
Urine, Substitute for, in Leather-dressing	496	Material from Ozokerit	35
Test for Acetone in	287	Waterproofed Wire Gauze	671
<i>Urtica Nivea</i> , Fibre of	76	Waterproofing Composition	36, 406
		Compound	409
Vacuum Desiccator with Heater (illus.)	175	Fabrics, etc.	321, 322
Pan for Sugar Liquor	330	Pile Goods	259
Valves for Acids, etc.	459	Weld, Dyeing with	528
Valves and Taps for Acids	508	Wheat Germ, Composition of	285
Vanadic Acid, Titration of Soda in presence of	679	Sugars in	36
Vanadium Determination	516	Wicks for Gas Burners	418
Vanillin	676	Wind, Storage of Force of (illus.)	158
In Asparagus	243	Wine Analyses	546
Manufacture	456	Coal-tar Colours detected in	178
Reaction of	252	Detection of Alkanet in	30
Synthesis	247	Determination of Dry Extract	612
Vapour-density Determination (illus.)	510	Extract and Glycerol determined in	509
Vapour Engine	316	Finings	613
Tensions, Curves of	131	Glycerin estimated in	457
Vapours from Liquids, Separation of (illus.)	408	Influence of Processes on	386
Varnish	103	Lees, Determination of Tartaric Acid in	497
For Transfers	609	Manufacture, Artificial	170
For Wood, Metal, etc.	452	Wines, Alsatian, Analyses of	197
Varnishes	222	Distinguishing Artificial Colours in	548
Resin-acid Ethers for	523	"Etc., treated with Electricity	453
Vat-Liquor, Treatment of	32	Treatment of	244
Vegetable Products, Preservation of	431	Unfermented	453
Vegetation, Formation of Oxalic Acid in	541	Wire Network inserted in Glass, Porcelain, etc.	536
Vernine	473	Wood, Extraction of Cellulose from	106
Vetches, Nitrogenous Constituent of	473	As a Paper-making Material	273, 319
Vinegar	613	Preservation of	492
Detection of Sulphuric and Hydrochloric Acids in	509	Preserving Compound for	452
Vines, Estimation of Copper in	169	Preservation	31
Presence of Copper in	496	Rendered Incombustible	420
Protection of	436	Wool Batching, Oils for	343
Treated with Alkali Waste and Sulphate of Copper	469	Composition of Grease from	539
Violet Colours, Discrimination of	252	Dyeing	533
Viscid Liquids, Sampler for (illus.)	211	Dyeing, Influence of Lime and Magnesia in	530
"Substances, Treatment of (illus.)	233	Fat, Treatment of	671
"Viscom" for Thickening Oils	608	Grease	578
Viscometry (illus.)	121, 148	Mordanting	526
Viscosimetry (illus.)	121, 148	Scouring	96, 97
Viscosity of Oils (illus.)	349	Washing	533, 604
Of Petroleum (illus.)	371	Woollen Fabrics, Soap-paste for	329
Of Soap Solutions	91	Goods, Black Spots produced on Paper by	637
Vitriol Stone, Composition of	30	Woven Fabrics, Aniline Black on	606
Vitriolised Ash, Purification of Water by	499	Fabrics, Treatment of	533
Vulcanising Indiarubber	638	Goods, Dyeing Machine for (illus.)	231
		Writing, Paper for Indelible	329
Wages, Comparison of English and German	352		
Wall Covering, Composition for	609	Xanthopurpurin, Synthesis	329
Wash-bottle (illus.)	342	Xylenes, Amido-azo-Derivatives of the	27
Washing Apparatus, Automatic (illus.)	650	Xylidines, Commercial	508
And Cleansing, Fluid for	165	Xylorcinol	509
Machine	600		
Ores	431	Yarns, etc., Centrifugal Dyeing Machine for	239
Precipitates in Air free from Carbonic Acid (illus.)	507	Yeast	542
Waste Gases, Regeneration of	160	Purification of	434
Liquors from Silk Dressing, Treatment of	378	Yellow Colours, Discrimination of	251
Liquors, Treatment of	242		
Liquors, Utilisation of	496	Zinc, Action of Oils on	263
Slimes and Blendes, Paints made from	432	Amount of Thallium in	493
Water, Bacteriological Examination of	331	Apple Chips containing	498
Detection of Metals in	84	Blende, Mercury and Sulphurous Acid from	531
Feeder for Boilers	267	Chloride, Manufacture	99
Filtering and Softening (illus.)	223	Coating Metals with	452
Gas, Furnace for	124	Containing Lead, Behaviour on Re-melting	337
From Hot Spring of Leuk, Composition of	305	Copper-couple, Treatment of Water with	266
Koch's Test for (illus.)	114	Decomposition of Water by Commercial	167
Micro organisms in	541	Detection of Traces in Water	84
Obtaining Fresh, from Salt	394	Determination of	502, 509
Oxygenated	653	Distillation	607
Purification of (illus.)	38, 39, 261, 388	Dust Reactions	394
Purification for Boilers	158	Extraction from Burnt Pyrites	101
Purification of Refuse	513	From Galvanisers' Dress	615
Purification and Treatment of	644, 650	Oxide, Rosin treated with	432
Settling Tank for Foul	368	Paints	384
Storage of Force of (illus.)	158	Powder, Valuation of (illus.)	115
Systematic Filtration of (illus.)	416	Separated from Cadmium	11
Treatment for Technical Purposes (illus.)	267	Sulphide	602
Vapour Tension of	134	White	609
Viscosity of	119		

Society of Chemical Industry.

BYE-LAWS,

*AS AMENDED AT THE ANNUAL GENERAL MEETING AT LIVERPOOL,
JULY 14, 1886.*

1. The Association is to be known as "THE SOCIETY OF CHEMICAL INDUSTRY," and is established in accordance with the provisions of the Literary and Scientific Institutions Act, 1854.

OBJECTS.

2. The objects for which the Society is established are :—

A. To advance Applied Chemistry in all its branches.

B. To afford its Members opportunities for the interchange of ideas with respect to improvements in the various Chemical Industries ; and for the discussion of all matters bearing upon the practice of Applied Chemistry ; and to publish information thereupon.

C. To acquire and dispose of property for the purposes aforesaid.

D. To do all other things incidental or conducive to the attainment of the above-named objects, or any of them.

MANAGEMENT.

3. The whole of the affairs of the Society shall be managed by a Council, consisting of a President, twelve Vice-Presidents, twelve Ordinary Members of Council, a Treasurer, a Foreign Secretary, and the Chairmen and Honorary Secretaries of the various local Sections.

4. A General Secretary shall be appointed by the Council, which shall have power to pay him such salary as it may think fit. His duties shall be defined by the Council from time to time.

5. Two Auditors, at least one of whom shall be a Member of the Society, but not a Member of the Council, shall be elected at each Annual General Meeting, to examine the accounts and statements submitted by the Council : or a Professional Accountant may be appointed and paid out of the funds of the Society.

6. The Council for the time being shall be the custodian of the funds and property of the Society, and may invest or use the same in such a manner as the Council may think fit for the purposes of the Society as defined by its Bye-laws.

ELECTION OF OFFICE-BEARERS.

7. Except as otherwise provided by Bye-laws 4, 23, and 24, all office-bearers shall be elected at Annual General Meetings of the Society, and by ballot.

8. The persons to be submitted for election at Annual General Meetings to the offices of President, Vice-President, Honorary Treasurer, and Honorary Foreign Secretary, shall be nominated by the Council. Those to be submitted for election to the office of Ordinary Member of Council, shall be nominated as provided by Bye-laws 17, 18, and 19.

9. The Honorary Treasurer and the Honorary Foreign Secretary shall retire annually, but shall be eligible for re-election.

10. The President shall hold office for one year, retiring at the close of the Annual General Meeting next following that at which he was elected, but shall be eligible for re-election.

11. When the President who is about to retire is not nominated for re-election to the office of President, he shall always be one of the persons nominated by the Council for election to the office of Vice-President.

12. Four Vice-Presidents shall retire each year, and those who thus retire shall not be eligible for re-election to the Council, except under Bye-laws 23 and 24, until the Annual General Meeting next following that at which they retire. When a Vice-President is nominated by the Council for election to the office of President, the Vice-President thus nominated shall not be counted among the four Vice-Presidents who are to retire,

13. Except that any Vice-President may be nominated by the Council for election to the office of President, and that such Vice-President, if any, shall not be included in the operation of the present Bye-law, the Vice-Presidents shall retire as far as may be possible in the order in which they were elected. When the four who must retire cannot all be Vice-Presidents who have been in office for the longest period, such number of them as may be necessary shall be selected by the Council, by ballot, from among those of the Vice-Presidents who have been in office for the next longest period.

14. Any Member of the Society who is not in arrear with his subscriptions, except as otherwise provided by Bye-law 12, may be nominated and elected to the office of Vice-President.

15. Four Ordinary Members of Council shall retire each year, and those who thus retire shall not be eligible for re-election to the Council, except under Bye-laws 23 and 24, until the Annual General Meeting next following that at which they retire. When an Ordinary Member of Council is nominated for election to the office of President, and when an Ordinary Member or two or more Ordinary Members of Council may have been nominated for election to the office of Vice-President, the Member or Members so nominated shall not be counted among those who are to retire.

16. Except that any Ordinary Member of Council may be nominated for election to the office of President, or to that of Vice-President, and that the Members, if any, who have been so nominated, shall not be included in the operation of the present Bye-law, the Ordinary Members of Council shall retire as far as may be possible in the order in which they were elected. When the four who must retire cannot all be members who have been in office for the longest period, such number of them as may be necessary shall be selected by the Council, by ballot, from among those of the Ordinary Members of Council who have been in office for the next longest period.

17. If, by reason of any Ordinary Member of Council, or any two or more Ordinary Members of Council, having been nominated for election to the office of President, or to that of Vice-President, the number of Ordinary Members of Council to be elected at the ensuing Annual General Meeting shall be greater than four: the Council shall nominate the number in excess of four of the persons to be submitted to that Annual General Meeting for election as Ordinary Members of Council, and four shall be nominated as provided by Bye-laws 18 and 19.

18. At least two months before the date of each Annual General Meeting, the Council shall issue to each Member of the Society a list of the Council, showing which of its Members are to retire at the date of that meeting, and giving the names of the persons who have been nominated by the Council for election at that meeting to the office of Vice-President, and also the names of the persons, if any, who have been nominated by the Council under Bye-law 17 for election to the office of Ordinary Member of Council, and inviting nominations to the four of the vacancies about to occur, persons to fill which have not been nominated by the Council. Such nominations must be made upon a printed form, which will be supplied to any Member of the Society at his request, addressed to the General Secretary, and which form shall be as follows:—

SOCIETY OF CHEMICAL INDUSTRY.

*We, the undersigned Members of this Society, do hereby propose
..... of
in the County of as a candidate for elect on as a
Member of Council of the Society, and I, the said
am willing to stand for election, and if elected will endeavour to attend the
Council Meetings, and do all in my power to promote the welfare of the Society.*

(SIGNED)

1.....	16.....
2.....	17.....
3.....	18.....
4.....	19.....
5.....	20.....
6.....	21.....
7.....	22.....
8.....	23.....
9.....	24.....
10.....	25.....
11.....	26.....
12.....	27.....
13.....	28.....
14.....	29.....
15.....	30.....

No such nomination shall be valid unless it be signed by at least ten Members of the Society, who are not in arrear with their subscriptions, nor unless it be received by the General Secretary, at the Society's Office, at least one month before the date of the commencement of the Annual General Meeting, to the election to take place at which it refers. Nor shall any such nomination be valid if the person nominated be ineligible for election under Bye-law 12 or Bye-law 15. No Member shall sign more than one Nomination Form.

19. If the number of persons nominated, as provided by Bye-law 18, be fewer than four, the further number necessary shall be nominated by the Council.

20. A complete List of the Council, showing which of its Members will retire at the forthcoming Annual General Meeting, and the names of all persons who have been nominated for election at that meeting, shall be printed as a Ballot List, and this Ballot List shall be sent to each Member of the Society at least five days before the commencement of the said Meeting.

21. On the first day of the said Meeting, at such stage of its proceedings as shall be most convenient, the Members present shall hand their Ballot Lists to the General Secretary, or, in his absence, to such other person as the President may appoint. Members unable to attend the Meeting may send their Ballot Lists before the Meeting to the General Secretary in sealed envelopes. Each such sealed envelope must be marked **BALLOT LIST**, and must, moreover, have written upon it the name of the Member sending it. The names written upon such sealed envelope having been compared with the Society's Register by the General Secretary, such sealed envelopes shall be opened at the Meeting by Scrutators appointed by the Meeting. The Scrutators shall see that the conditions of the ballot are strictly fulfilled.

22. Any Member shall be at liberty to strike out any name or names of ordinary Members of Council printed on his voting paper, provided that the names so struck out are those in excess of the number of vacancies to be filled up.

23. If the office of President should become vacant by death or resignation during the period intervening between two Annual General Meetings, a new President shall be elected by the Council.

24. If any other vacancy shall occur in the Council during the period intervening between two Annual General Meetings, the Council shall elect a person to fill it until the next Annual General Meeting, when the Member who has been so elected by the Council shall retire, in addition to those who retire under Bye-laws 12 and 15. Such Member, however, shall be eligible for re-election, and shall be nominated for re-election at the Annual General Meeting next following his election by the Council.

MEMBERS AND THEIR CONTRIBUTIONS.

25. Every Candidate for admission as a Member of the Society must be proposed according to the form set out in Rule 26. He must be proposed by one or more Members to whom he is known personally. The proposal form must be sent duly signed to the General Secretary, who shall lay the same before the Council at its next Meeting. If the majority of the Members of Council present are in favour of his election, the candidate shall be declared duly elected, and his name shall be entered in the Register of the Society. At whatever period of the year a new Member may be elected, he shall be required (unless the Council shall determine otherwise) to pay his subscription for that year; having done which he shall be entitled to receive all the numbers of the Society's Journal for that year.

26. The Nomination Paper must take the following form, and may be obtained from the General Secretary, or from any of the Secretaries of Local Sections:—

THE SOCIETY OF CHEMICAL INDUSTRY.

(Candidate's Name in full)
is hereby proposed as a fit and proper person to become a Member of the
Society of Chemical Industry.

For Names only of
Members recommend-
ing the Candidate. }

Signature of Candidate

Address to which the
Candidate wishes the
Society's publications
to be sent, and which
is to be entered in the
Society's Register. }

Profession or Business
Occupation. }

Date

27. Each Member shall pay an annual subscription of Twenty-five Shillings, due on the First of January in each year; but any Member may pay a life composition fee of Fifteen Pounds in lieu of an annual subscription.

28. A List of the Members of the Society, with their addresses, shall be printed and distributed to each Member of the Society in the month of January in each year.

29. No person shall be entitled to the privileges of Membership who is in arrear with his subscription. No Member, whose subscription has not been paid, shall be entitled to attend Meetings or to vote, or to receive gratuitously any of the publications of the Society; and if the subscription be not paid within four months after further application from the Secretary, due notice shall be given to the Member, whereupon his name shall be struck off the register: he shall cease to have any right, privilege, or interest in the Society, and the arrears of subscription shall be recovered at law.

30. Any Member may withdraw from the Society at the end of any year, after giving notice to the General Secretary of his desire to withdraw, such notice to be accompanied by the payment of all arrears, if any, which may be due from him to the Society up to that date, and by such notice and payment he shall be released from all further liability as a Member.

MEETINGS.

31. The Council shall meet periodically, to examine accounts, to authorise payments, to act as a Committee of Finance, and to transact such business as may be necessary. Its meetings shall be convened by circular posted to all its Members, either by the order of the Council itself, given at a previous meeting, or by instruction from the President; and at any Meeting of the Council thus duly convened five Members shall constitute a quorum. The circular convening each Meeting shall be accompanied by an agenda paper, stating the nature of the business to transact which the meeting is called, and also by a list of candidates for membership, if any, who are to be proposed for election at such meeting, with the address and occupation of each such candidate.

32. For the furtherance of the objects of the Society, for advice, examination of and reports upon novelties, improvements, inventions, processes, or other matters of interest in connection with the chemical industries, the Council may appoint Special Committees, which may consist in part or entirely of persons other than Members of the Council. Such persons must be Members of the Society, and all Special Committees shall be under the control of the Council. The President for the year shall be the Chairman of all Special Committees, and the General Secretary of the Society shall be the Secretary of them, unless otherwise arranged by the Council.

33. No Special Committee, nor any Committee of Local Section, shall have any control over the funds of the Society, except to the extent to which funds for its use may be voted by the Council. An account of the manner in which any funds so voted for the use of any Committee have been expended shall be furnished to the Council on or before the 31st of December in each year.

34. An Annual General Meeting of the Members of the Society shall be held at such time and place as shall have been decided at the previous Annual General Meeting, to receive a Report from the Council, to elect office-bearers, to hear an address by the President, and to transact such other business as may be necessary or desirable, including, if the Council think fit, the reading and discussion of papers.

35. Notice of each Annual General Meeting shall be given in the Journal of the Society at least fourteen days before the day on which such Meeting is to commence.

36. The order of the business to be transacted at the Annual General Meetings shall be decided by the Council from time to time.

37. A Member may introduce one visitor at any General or Local Meeting of the Society. Such visitor may, by leave of the Chairman, take part in any discussion, but he shall not vote.

38. The Council may accept communications from gentlemen not Members of the Society, and allow them to be read before the Members.

MISCELLANEOUS.

39. If any person proposed to the Council for election as a Member of the Society be rejected, no record of his rejection shall be placed upon the minutes.

40. All papers proposed to be read before a General Meeting of the Society must be sent to the General Secretary fourteen days at least before the date of that Meeting. The Council shall allow them to be read or ask that they be amended, or reject them, as it thinks fit.

41. The Society shall have the right of priority of publication for three months of all communications made to the Society.

42. A Journal of the Society shall be published at least once a month, and shall be distributed gratuitously to the Members of the Society, except that no member of the Society shall be entitled to receive it who has not paid his subscription.

43. The author of any communication which has been read before the Society or before any of its Local Sections, and the publication of which in the Society's Journal has been authorised by the Council, may receive not more than fifty copies of such communication, together with the discussion thereon, if the author desires it, printed separately, provided that he gives notice of his desire to receive such copies upon the manuscript of his communication forwarded by him to the Editor of the Journal.

44. The Journal of the Society shall be edited and managed as the Council shall prescribe from time to time. Nothing shall appear in it, the publication of which has not been authorised by the Council, or by a Publication Committee appointed by the Council. It shall contain, in full or in abstract, as the Council may in each case decide, such of the communications read before the Society or any of its Local Sections as the Council may consider it desirable to publish, together with such other matter, relating to applied chemistry and the practice thereof, as the Council may from time to time direct.

LOCAL SECTIONS.

45. Upon receiving a requisition signed by at least thirty Members of the Society from any particular district, the Council shall consider the advisability of allowing a Local Section for that district to be formed.

46. Each Local Section may make rules for its own government, but no such rules shall be valid unless and until they have been sanctioned by the Council of the Society, and such rules must in each case include the following provisions :—

(a) That the affairs of the Section shall be conducted by a Committee, which shall be elected by the Members of the Section, in such manner as the rules of the Section shall provide.

(b) That, except elections to fill up unforeseen vacancies, all elections to the Committee of a Local Section, and all election of Officers of the Section, whether such Officers be appointed by the Committee or otherwise, shall take place in the month of April, and that the names of the persons elected shall in each case be reported to the Council on or before the 20th of that month; but that the members of Committee and the officers thus elected or appointed in April shall not take office, and those whom they are to succeed shall not retire from office, in each case until the close of the session then current.

(c) That no modification of or addition to the rules of the Section shall be made without the consent of the Council of the Society.

47. When the Council has consented to the formation of a Local Section of the Society, and has approved the rules by which it is proposed that that Section shall be governed, the Chairman and Honorary Secretary of that Section shall be *ex-officio* Members of the Council of the Society.

48. Each Local Section shall be bound to defray its own expenses for printing, stationery, advertising, postage, reporting, and hire of rooms; but the Council shall make a grant in aid thereof out of the General Funds of the Society, or may, if it think fit, defray the whole thereof.

49. An account of the expenditure of each Local Section during the preceding twelve months shall be furnished to the Council on or before the 15th of June in each year.

50. Except for printing, stationery, advertising, reporting, postage, and hire of rooms, no Local Section shall incur any expense without having previously obtained the sanction of the Council thereto.

51. For the purpose of meeting its expenses, each Local Section may require its Members to pay a Sectional subscription, which, however, shall not exceed Five Shillings per annum.

52. Every Member of the Society shall be entitled to attend, and to take part in the proceedings of the meetings of all Local Sections, except meetings concerning the business management of any Section of which he is not a Member.

53. The Committees of Local Sections shall have power to accept or reject communications proposed to be read before such Sections.

ALTERATION OF THE BYE-LAWS.

54. Any Member of the Council may submit to the Council in writing any proposal to alter or add to the present Bye-laws, and the Council may submit such proposal to the ensuing Annual General Meeting, if it think fit; but the Council shall submit such proposal to such Annual General Meeting, on a requisition to that effect, signed by at least Twenty Members of the Society, who are not in arrear with their subscriptions, provided that no proposed alterations of, or additions to the Bye-laws shall be considered at any Annual General Meeting, unless at least one month's notice thereof has been posted to every Member of the Society.

EXTRAORDINARY MEETINGS.

55. Extraordinary General Meetings of the Society may be convened at any time by the President and Council, or on receipt of a written requisition, signed by at least Thirty Members of the Society. The circular calling the Meeting must state the objects thereof, and must be delivered or sent by post to each Member of the Society at least fourteen days before the proposed Meeting is to take place.

LIST OF MEMBERS.

A

Abbott, John, Braemar House, Lancaster Gate, Hyde Park, W.
 Abel, Sir F. A., Royal Arsenal, Woolwich, London, S.E.
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 Addie, J., Langloan Ironworks, Coatbridge, N.B.
 Addyman, F. T., 17, Tenmyson Street, Nottingham
 Adkins, H., Chemical Works, Smethwick
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 Akitt, Thomas, 3, Victoria Road, Leuzie, N.B.
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 Albright, W. A., Mariemout, Birmingham
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 Alexander, W. T., 20, Booth St., Mosley St., Manchester, and Crummock Bank, Victoria Crescent, Eccles
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 Allen, J. Fenwick, Newham, Whalley Range, Manchester
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 Allen, Wm., Edenholme, Bournemouth, Hants
 Allen, W. H., c/o F. Stearns & Co., Detroit, Mich., U.S.A.
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 Allhusen, A., Gateshead-on-Tyne
 Allhusen, Wilton, 102, Quay Side, Newcastle-on-Tyne
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 Anderson, John, Cambroie Ironworks, Coatbridge, N.B.
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 Arcimis, Aug., 43, Paseo de las Acacias, Madrid
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 Arthur, W. (present address unknown).
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B

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C

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- Chance, J. F., Alkali Works, Oldbury, near Birmingham
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 Twynam, T., 54, Minford Gardens, West Kensington Park, London, W.
 Typke, P. G. W., Fairlawn, New Malden, Surrey
 Tyrer, T., Garden Wharf, Battersea, London, S.W.

U

Umney, C., 50, Southwark Street, London, S.E.
 Underwood, G. R., Mass. Inst. of Technology, Boston, Mass., U.S.A.
 Upward, W., Deacon Road, Appleton-in-Widnes
 Usmar, J. H., 31, Threadneedle Street, London, E.C.

V

Valentine, G., 429, Scotland Road, Liverpool
 Vasey, T. E., 6, South Parade, Leeds; and 27, Corn Exchange Chambers, Mark Lane, London, E.C.
 Vaughan, J. L., Woodleigh, East Dulwich Grove, S.E.
 Venables, T., Parkborn Chemical Works, Kirkintilloch, N.B.
 Verdin, Jos., The Broekhurst, Northwich, Cheshire
 Verel, F. W., The Linn, Cathcart, Glasgow
 Verel, W. A., 136, West George Street, Glasgow
 Vickers, W., Rose Hill, Smedley Lane, Manchester
 Vieth, P., 31, St. Petersburg Place, Bayswater, London, W.
 Vint, W. F., The Cedars, Sunderland
 Virtue, W., Kngl. Landwirtschaftlichen Schule, Weihenstephan, Bavaria
 Voelcker, E. W., 11, Salisbury Square, Fleet Street, London
 Voss, Hermann, Holstein House, Whitworth Road, South Norwood, S.E.

W

Waché, Alf., 19, Rue Reanmur, Paris
 Wager, H. W. T., 16, Charlotte Street, Portland Place, London, W.
 Wainwright, J. H., 402, Washington Street, New York, U.S.A.
 Walker, A., Irvine Chemical Co. Limited, Irvine, N.B.
 Walker, Hugh W., 37, Fox Street, Greenock, N.B.
 Walker, Geo., City Analyst's Laboratory, 138, Bath Street, Glasgow
 Walker, R., The Pallett, Quarlton, near Bolton
 Walker, R. W., Quarlton Vale Printworks, Turton, near Bolton
 Walker, S. R., 21., School Street, Radcliffe, Manchester
 Walker, T., Merton Bank Chemical Works, St. Helens
 Wall, R. F., Thames Sugar Refinery, Silvertown, London, E.
 Wallace, Robert, 126, St. Leonard's Street, Bromley, London, E.
 Wallace, W., 138, Bath Street, Glasgow
 Waller, E., School of Mines, Columbia College, 50th Street, 4th Avenue, New York, U.S.A.
 Walsh, P. H., Salt and Manure Works, Weston, Stafford
 Waltham, T., Brewery, Stockwell, London, S.W.
 Walton, John, Hall's Wharf, Victoria Docks, London, E.
 Warburton, J., Kearsley House, Farnworth, near Bolton
 Ward, G., Messrs. Hirst, Brooke & Hirst, Leeds
 Ward, Howard Chas., Yeatton, Hordle, Lymington, Hants.
 Wardale, J. D., Redhugh Engine Works, Gateshead-on-Tyne
 Wardale, H., 52, Bewick Road, Gateshead-on-Tyne
 Warden, C. J. H., Medical College, Calcutta, India
 Waring, E. S., Lillie Terrace, Castle Street, Sreinton, Nottingham
 Warne, Thos., c/o Messrs. W. Hunt & Sons, Chemical Works, Wednesbury

- Warner, H. G., County Bridge, Ash, Surrey
 Warren, T. T. P. Bruce, Tamworth Villa, Earlsall
 Grove, Forest Gate, Essex
 Warrington, A. W., 1A, Nikolausberger Weg, Göttingen,
 Hanover
 Warrington, Robt., Harpenden, Herts.
 Warwick, Jno., Rye Hill, Newcastle-upon-Tyne
 Warwick, J. F., The Brewery, Newark-upon-Trent
 Waterfall, W. B., c/o Avon Manure Co., Bristol
 Watkins, R. R., Cropper's Hill, St. Helens
 Watson, Chas., 5, Paradise Row, Stockton-on-Tees
 Watson, D., Broughton Copper Works, Manchester
 Watson, G., jun., 16, East Nelson Street, Whitevale,
 Glasgow
 Watson, J. C., The Rhyddings, Church, near Accrington
 Watson, J. D., Braystones, near Whitehaven
 Watson, J. Donald, 23, Cross Street, Finsbury, London,
 E.C.
 Watson, Jno., Cement Works, Gateshead-on-Tyne
 Watson, Jno., jun., Laboratory, Newcastle Chemical
 Co., Gateshead-on-Tyne
 Watson, W. H., The Laboratory, The Folds, Bolton
 Watt, A., 89, Hartington Road, Sefton Park, Liverpool
 Watts, A. J., Engo, Central de Bom Gorto, Agna Preta,
 Pernambuco, Brazil
 Webb, Saml. G., 38, Montpelier Road, Peckham, S.E.
 Webster, C. S., Stanford, Malvern House, Redland, Bristol
 Wehler, Theodore, 32, Liberty Street, New York, U.S.A.
 Weightman, John F., c/o Powers & Weightman, Phila-
 delphia, Pa., U.S.A.
 Weldon, Ernest, 86, North Gate, New Basford, Notting-
 ham
 Weldon, Osmond, 66 North Gate, New Basford, Notting-
 ham
 Wells, G. I. J., 4, Cavendish Terrace, Arundel Avenue,
 Sefton Park, Liverpool
 Welsh, Jas., Clayton Mount, Newton Heath, near Man-
 chester
 Welsh, W., Orleton House, Whalley Range, Manchester
 Wessel, Carl, Bernburg, Anhalt, Germany
 West, John, Barfield House, Didsbury, near Manchester
 Westmoreland, J. W., 25, Park Square, Leeds
 Weston, Wm., H.M. Dockyard, Portsmouth
 Wethered, J., The Avenue, Clifton, Bristol
 Wetzel, H. A., Box 470, Detroit, Michigan, U.S.A.
 Whalley, L. J. de, Florence House, Fairlop Road,
 Leytonstone, E.
 Wharton, A., Gas Works, Basford, Nottingham
 Wheen, F., Deptford Creek, London
 Whewell, G., Regent Chambers, Blackburn
 Whiffen, T., Lombard Road, Battersea, London, S.W.
 Whiffen, T., jun., Lombard Road, Battersea, London,
 S.W.
 Whiffen, W. G., Lombard Road, Battersea, London, S.W.
 Whitaker, T., Messrs. E. Ripley & Sons, Bradford,
 Yorks.
 Whitaker, Thos., 22, Delannays Road, Higher Crumpsall,
 Manchester
 Whittaker, C. J., 75, Plantation Street, Accrington
 White, A., Horton Field, West Drayton, Middlesex
 White, A. D., Avenue House, West Drayton, Middlesex
 White, P. T., Castle Street, Saffron Hill, London, E.C.
 White, W. H., Killingworth House, Killingworth,
 Newcastle-on-Tyne
 Whitelaw, A., 87, Sidney Street, Glasgow
 Whitelaw, T. N., 87, Sidney Street, Glasgow
 Whiteley, Geo., Victoria Lead Works, Burdett Road,
 Limehouse, E.
 Whiteley, R. Lloyd, University College, Nottingham
 Whowell, F., Carr Bank, Tottington, Bury, Lancashire
 Wigg, C., Runcorn
 Wigg, G. L., Runcorn
 Wigg, Walter J., Old Quay Copper and Alkali Works,
 Runcorn, Cheshire
 Wiggan, H., M.P., Metchley Grange, Harborne, near
 Birmingham
 Wiggan, W. W., Metchley Grange, Harborne, near
 Birmingham
 Wightman, C., 151, Fenchurch Street, London, E.C.
 Wild, Eugene, Technikum, Winterthur, Switzerland
 Wilde, T., Spring Place, Rhiwderin, Newport, Mon.
 Wilding, S. P., 1, Queen Victoria Street, Mansion
 House, London, E.C.
 Wildsmith, J. H. S. (address unknown)
 Wiley, M. W., 1 Bell Terrace, West Hartlepool
 Wilkin, Walter H., Appold Street, Finsbury, E.C.
 Will, J. Shiress, Q.C., M.P., 3, Pump Court, Temple,
 London, E.C.
 Will, W. Watson, Ossory Villa, Ossory Road, London, S.E.
 Williams, J. W., 28, Deansgate, Manchester
 Williams, C. Greville, Layfield, Bolingbroke Grove,
 Wandsworth, S.W.
 Williams, J. H., Buckingham Street, London, W.C.
 Williams, J. W., 6, Giltspur Street, London, E.C.
 Williams, M. W., Queenwood College, near Stockbridge,
 Hants.
 Williams, Rowland, 9, Albert Square, Manchester
 Williams, T., 3, York Buildings, 14, Dale Street, Liver-
 pool
 Williams, T. Howell, 10, Ascham Street, Kentish Town,
 N.W.
 Williams, T. H., Bank House, Garston
 Williams, W., Carleton, Firth College, and 33, Broom-
 grove Road, Sheffield
 Williams, W. J., c/o Col. J. V. Dunne, 305, Walnut
 Street, Philadelphia, Pa., U.S.A.
 Williamson, A. W., University College, London, W.C.
 Williamson, Jos., c/o Messrs. Gossage & Sons, Soapworks,
 Widnes
 Williamson, J. H., Goldenhill Works, Stoke-on-Trent
 Williamson, Jno., Jarrow Chemical Works, South Shields
 Williamson, Robt., Osborne Villas, Cheetham Hill
 Road, Manchester
 Wills, G. S. V., Gladstone House, St. George's Road,
 Southwark, London, S.E.
 Wills, J. L., 32, Rue Grande-Barre, Cahors, Lot, France
 Wills, S. J., Castle Green Colour Works, Bristol
 Wilmot, H. E., 44, Westbourne Park, London, W.
 Wilputte, N. L., 13, Park Road, Ebbw Vale, Mon.
 Wilson, A., Stafford
 Wilson, Alexander, Caroline Park, Granton, N.B.
 Wilson, Anthony W., 10, Westcote Street, Hull
 Wilson, C. T., University College, London, W.C.
 Wilson, David W. R., Sinderby, Thirsk, Yorkshire
 Wilson, Frank, The Brewery, Castle Street, Long Acre,
 London, W.C.
 Wilson, F. H., Desoto Alkali Co., Limited, Widnes
 Wilson, G., jun., Cairnview, Kirkintilloch, Dumbarton-
 shire
 Wilson, G. E., The Chemical Works, Oldbury, near
 Birmingham
 Wilson, H. J., Osgathorpe Mills, Pitt-moor, Sheffield
 Wilson, Jno. Ed., Wyddrington, Edgbaston, Birming-
 ham
 Wilson, Jno., Redhugh Chemical Works, Gateshead-on-
 Tyne
 Wilson, J. H., East Ham, Essex; and 6, Fenchurch
 Buildings, E.C.
 Wilson, R. H., Eaglescliffe, Yarm-on-Tees
 Wilson, W. H., Presidency College, Madras
 Wilton, Geo., Gas Works, Silvertown, E.
 Wilton, Jno., Clydesdale, Norwich Road, Forest Gate,
 Essex
 Wilton, Thos., Tar and Liquor Works, Gas Light & Coke
 Co., Beckton, E.
 Windos, W., 1, Hughtenden Road, Clifton, Bristol
 Wingham, A., Broughton Copper Works, Manchester
 Winsor, P. J., c/o Lever, Bros., Soap Work, Warrington
 Winsloe, H., Messrs. Tennant & Co., 49, Faulkner
 Street, Manchester
 Winstone, A. B., 100, Shoe Lane, E.C.
 Wishart, G. J., 8, Dryden Street, Edinburgh
 Witt, Otto N. E., 8, 13, Mannheim, Germany
 Wolfenden, S., Wellington Terrace, Cowley Hill, St.
 Helens
 Womersley, P. B., the Lilies, Upton Lane, West Ham
 Wood, C. H., 46, Lorraine Road, Holloway, London, N.
 Wood, Robt. B., Dalquhurn Works, Renton, N.B.
 Wood, W. C., Avenue Cottage, Alexandria, Dumbar-
 tonshire
 Wood, W. H., Northgate Chambers, Halifax; and
 111, Victoria Street, Westminster, S.W.

Woodcock, R. C., 69, Bromfelde Road, Clapham, London, S.W.
 Woodhead, Jas., Ashfield Terrace, Slaithwaite, near Huddersfield
 Woodland, J., 173, Marylebone Road, London, N.W.
 Woods, W. A., The House, Johnson's Saccharum Co., Carpenter's Road, Stratford, London, E.
 Woodward, E., Whitfield Mount, Upton, Macclesfield
 Woodward, J. H., Houlton Street, Bristol
 Woodward, W. C., Biddulph Valley Coal & Iron Works, Stoke-on-Trent
 Woolley, G. S., 69, Market Street, Manchester
 Wootton, A. C., 44A, Cannon Street, London, E.C.
 Worrall, H., Crimsworth, Groby Road, Altrincham, Manchester
 Worrall, J., Whalley Range, Manchester
 Worsley, P. J., Netham Chemical Co., Bristol
 Wray, O. J. P., British Alizarin Co. Limited, Silver-Town, Victoria Docks, London, E.
 Wright, A. R., The Patent Office, 25, Southampton Buildings, Chancery Lane, London, W.C.
 Wright, Jos., 19 Arboretum Street, Nottingham
 Wright, Joshua, 13, Alton Terrace, Manchester Road, Fairfield, near Manchester
 Wright, W., Fairfield Road Chemical Works, Droylsden, Manchester
 Wright, C. R. A., St. Mary's Hospital, Paddington, London, W.
 Wright, Jas. C., 14, Hill Street, Irvine, N.B.
 Wright, J. H., Seafeld House, Montgomerie Street, Irvine, N.B.
 Wright, L. T., Gas Offices, George Street, Nottingham
 Wuth, A., 67, Bolton Street, Ramsbottom, near Manchester

Wyatt, J. W., Nash Mills, Hemel Hempstead, Herts.
 Wykes, L., Tharsis Co. Works, Oldbury, Birmingham
 Wyld, J., Frizinghall Chemical Works, near Shipley, Yorks.
 Wyld, J. R., Heatherlea, Penketh, near Warrington

Y

Yardley, H. B., 17, Clarendon Villas, Charlton, Kent
 Yates, F., 64, Park Street, Southwark, London
 Yates, R., 64, Park Street, Southwark, London
 Yglesias, M., 2, Tokenhouse Buildings, London, E.C.
 Young, A. C., 64, Tyrwhitt Road, St. John's, S.E.
 Young, Brougham, Home Lyn, Woodberry Down, London, N.
 Young, C. Francis, 43, Manchester Old Road, Middleton, near Manchester
 Young, Jno., Kincaid House, Milton of Campsie, N.B.
 Young, Col. J. R., 20, Windsor Terrace, Newcastle-on-Tyne
 Young, J. R., 17, North Bridge, Edinburgh, N.B.
 Young, Robt., 3, Radstock Road, Fairfield, Liverpool
 Young, Sydney, 13, Aberdeen Terrace, White Ladies Road, Bristol
 Young, T. Graham, Limefield, West Calder, N.B.
 Young, W. C., 22, Windsor Road, Forest Gate, E.

Z

Zimmermann, A., 21, Mincing Lane, London, E.C.
 Zinkeisen, W., 4, Woodside Place, Glasgow

Society of Chemical Industry.

BYE-LAWS,

*AS AMENDED AT THE ANNUAL GENERAL MEETING AT LIVERPOOL,
JULY 14, 1886.*

1. The Association is to be known as "THE SOCIETY OF CHEMICAL INDUSTRY," and is established in accordance with the provisions of the Literary and Scientific Institutions Act, 1854.

OBJECTS.

2. The objects for which the Society is established are :—

- A. To advance Applied Chemistry in all its branches.
- B. To afford its Members opportunities for the interchange of ideas with respect to improvements in the various Chemical Industries ; and for the discussion of all matters bearing upon the practice of Applied Chemistry ; and to publish information thereupon.
- C. To acquire and dispose of property for the purposes aforesaid.
- D. To do all other things incidental or conducive to the attainment of the above-named objects, or any of them.

MANAGEMENT.

3. The whole of the affairs of the Society shall be managed by a Council, consisting of a President, twelve Vice-Presidents, twelve Ordinary Members of Council, a Treasurer, a Foreign Secretary, and the Chairmen and Honorary Secretaries of the various Local Sections.

4. A General Secretary shall be appointed by the Council, which shall have power to pay him such salary as it may think fit. His duties shall be defined by the Council from time to time.

5. Two Auditors, at least one of whom shall be a Member of the Society, but not a Member of the Council, shall be elected at each Annual General Meeting, to examine the accounts and statements submitted by the Council: or a Professional Accountant may be appointed and paid out of the funds of the Society.

6. The Council for the time being shall be the custodian of the funds and property of the Society, and may invest or use the same in such a manner as the Council may think fit for the purposes of the Society as defined by its Bye-laws.

ELECTION OF OFFICE-BEARERS.

7. Except as otherwise provided by Bye-laws 4, 23, and 24, all office-bearers shall be elected at Annual General Meetings of the Society, and by ballot.

8. The persons to be submitted for election at Annual General Meetings to the offices of President, Vice-President, Honorary Treasurer, and Honorary Foreign Secretary, shall be nominated by the Council. Those to be submitted for election to the office of Ordinary Member of Council, shall be nominated as provided by Bye-laws 17, 18, and 19.

9. The Honorary Treasurer and the Honorary Foreign Secretary shall retire annually, but shall be eligible for re-election.

10. The President shall hold office for one year, retiring at the close of the Annual General Meeting next following that at which he was elected, but shall be eligible for re-election.

11. When the President who is about to retire is not nominated for re-election to the office of President, he shall always be one of the persons nominated by the Council for election to the office of Vice-President.

12. Four Vice-Presidents shall retire each year, and those who thus retire shall not be eligible for re-election to the Council, except under Bye-laws 23 and 24, until the Annual General Meeting next following that at which they retire. When a Vice-President is nominated by the Council for election to the office of President, the Vice-President thus nominated shall not be counted among the four Vice-Presidents who are to retire.

13. Except that any Vice-President may be nominated by the Council for election to the office of President, and that such Vice-President, if any, shall not be included in the operation of the present Bye-law, the Vice-Presidents shall retire as far as may be possible in the order in which they were elected. When the four who must retire cannot all be Vice-Presidents who have been in office for the longest period, such number of them as may be necessary shall be selected by the Council, by ballot, from among those of the Vice-Presidents who have been in office for the next longest period.

14. Any Member of the Society who is not in arrear with his subscriptions, except as otherwise provided by Bye-law 12, may be nominated and elected to the office of Vice-President.

15. Four Ordinary Members of Council shall retire each year, and those who thus retire shall not be eligible for re-election to the Council, except under Bye-laws 23 and 24, until the Annual General Meeting next following that at which they retire. When an Ordinary Member of Council is nominated for election to the office of President, and when an Ordinary Member or two or more Ordinary Members of Council may have been nominated for election to the office of Vice-President, the Member or Members so nominated shall not be counted among those who are to retire.

16. Except that any Ordinary Member of Council may be nominated for election to the office of President, or to that of Vice-President, and that the Members, if any, who have been so nominated shall not be included in the operation of the present Bye-law, the Ordinary Members of Council shall retire as far as may be possible in the order in which they were elected. When the four who must retire cannot all be Members who have been in office for the longest period, such number of them as may be necessary shall be selected by the Council, by ballot, from among those of the Ordinary Members of Council who have been in office for the next longest period.

17. If, by reason of any Ordinary Member of Council, or any two or more Ordinary Members of Council, having been nominated for election to the office of President, or to that of Vice-President, the number of Ordinary Members of Council to be elected at the ensuing Annual General Meeting shall be greater than four: the Council shall nominate the number in excess of four of the persons to be submitted to that Annual General Meeting for election as Ordinary Members of Council, and four shall be nominated as provided by Bye-laws 18 and 19.

18. At least two months before the date of each Annual General Meeting, the Council shall issue to each Member of the Society a list of the Council, showing which of its Members are to retire at the date of that meeting, and giving the names of the persons who have been nominated by the Council for election at that meeting to the office of Vice-President, and also the names of the persons, if any, who have been nominated by the Council under Bye-law 17 for election to the office of Ordinary Member of Council, and inviting nominations to the four of the vacancies about to occur, persons to fill which have not been nominated by the Council. Such nominations must be made upon a printed form, which will be supplied to any Member of the Society at his request, addressed to the General Secretary, and which form shall be as follows:—

SOCIETY OF CHEMICAL INDUSTRY.

*We, the undersigned Members of this Society, do hereby propose.....
 of in the County of
 as a candidate for election as a Member of Council of the
 Society, and I, the said.....am willing to stand for election, and
 if elected will endeavour to attend the Council Meetings, and do all in my power to
 promote the welfare of the Society.*

(SIGNED)

1.....	16.....
2.....	17.....
3.....	18.....
4.....	19.....
5.....	20.....
6.....	21.....
7.....	22.....
8.....	23.....
9.....	24.....
10.....	25.....
11.....	26.....
12.....	27.....
13.....	28.....
14.....	29.....
15.....	30.....

No such nomination shall be valid unless it be signed by at least ten Members of the Society, who are not in arrear with their subscriptions, nor unless it be received by the General Secretary, at the Society's Office, at least one month before the date of the commencement of the Annual General Meeting, to the election to take place at which it refers. Nor shall any such nomination be valid if the person nominated be ineligible for election under Bye-law 12 or Bye-law 15. No Member shall sign more than one Nomination Form.

19. If the number of persons nominated, as provided by Bye-law 18, be fewer than four, the further number necessary shall be nominated by the Council.

20. A complete List of the Council, showing which of its Members will retire at the forthcoming Annual General Meeting, and the names of all persons who have been nominated for election at that meeting, shall be printed as a Ballot List, and this Ballot List shall be sent to each Member of the Society at least five days before the commencement of the said Meeting.

21. On the first day of the said Meeting, at such stage of its proceedings as shall be most convenient, the Members present shall hand their Ballot Lists to the General Secretary, or, in his absence, to such other person as the President may appoint. Members unable to attend the Meeting may send their Ballot Lists before the Meeting to the General Secretary in sealed envelopes. Each such sealed envelope must be marked BALLOT LIST, and must, moreover, have written upon it the name of the Member sending it. The names written upon such sealed envelope having been compared with the Society's Register by the General Secretary, such sealed envelopes shall be opened at the Meeting by Scrutators appointed by the Meeting. The Scrutators shall see that the conditions of the ballot are strictly fulfilled.

22. Any Member shall be at liberty to strike out any name or names of Ordinary Members of Council printed on his voting paper, provided that the names so struck out are those in excess of the number of vacancies to be filled up.

23. If the office of President should become vacant by death or resignation during the period intervening between two Annual General Meetings, a new President shall be elected by the Council.

24. If any other vacancy shall occur in the Council during the period intervening between two Annual General Meetings, the Council shall elect a person to fill it until the next Annual General Meeting, when the Member who has been so elected by the Council shall retire, in addition to those who retire under Bye-laws 12 and 15. Such Member, however, shall be eligible for re-election, and shall be nominated for re-election at the Annual General Meeting next following his election by the Council.

MEMBERS AND THEIR CONTRIBUTIONS.

25. Every Candidate for admission as a Member of the Society must be proposed according to the form set out in Rule 26. He must be proposed by one or more Members to whom he is known personally. The proposal form must be sent duly signed to the General Secretary, who shall lay the same before the Council at its next Meeting. If the majority of the Members of Council present are in favour of his election, the Candidate shall be declared duly elected, and his name shall be entered in the Register of the Society. At whatever period of the year a new Member may be elected, he shall be required (unless the Council shall determine otherwise) to pay his subscription for that year; having done which he shall be entitled to receive all the numbers of the Society's Journal for that year.

26. The Nomination Paper must take the following form, and may be obtained from the General Secretary, or from any of the Secretaries of Local Sections :—

THE SOCIETY OF CHEMICAL INDUSTRY.

(Candidate's Name in full)
is hereby proposed as a fit and proper person to become a Member of the Society
of Chemical Industry.

For Names only of }
Members recommend- }
ing the Candidate. }

Signature of Candidate.....

Address to which the }
Candidate wishes the }
Society's publications }
to be sent, and which }
is to be entered in the }
Society's Register. }

Profession or Business }
Occupation. }

Date.....

27. Each Member shall pay an annual subscription of Twenty-five Shillings, due on the First of January in each year; but any Member may pay a life composition fee of Fifteen Pounds in lieu of an annual subscription.

28. A List of the Members of the Society, with their addresses, shall be printed and distributed to each Member of the Society in the month of January in each year.

29. No person shall be entitled to the privileges of Membership who is in arrear with his subscription. No Member whose subscription has not been paid shall be entitled to attend Meetings or to vote, or to receive gratuitously any of the publications of the Society; and if the subscription be not paid within four months after further application from the Secretary, due notice shall be given to the Member, whereupon his name shall be struck off the Register; he shall cease to have any right, privilege, or interest in the Society, and the arrears of subscription shall be recovered at law.

30. Any Member may withdraw from the Society at the end of any year, after giving notice to the General Secretary of his desire to withdraw, such notice to be accompanied by the payment of all arrears, if any, which may be due from him to the Society up to that date, and by such notice and payment he shall be released from all further liability as a Member.

MEETINGS.

31. The Council shall meet periodically, to examine accounts, to authorise payments, to act as a Committee of Finance, and to transact such business as may be necessary. Its meetings shall be convened by circular posted to all its Members, either by the order of the Council itself, given at a previous meeting, or by instruction from the President; and at any Meeting of the Council thus duly convened five Members shall constitute a quorum. The circular convening each Meeting shall be accompanied by an agenda paper, stating the nature of the business to transact which the Meeting is called, and also by a list of candidates for membership, if any, who are to be proposed for election at such Meeting, with the address and occupation of each such Candidate.

32. For the furtherance of the objects of the Society, for advice, examination of and reports upon novelties, improvements, inventions, processes, or other matters of interest in connection with the chemical industries, the Council may appoint Special Committees, which may consist in part or entirely of persons other than Members of the Council. Such persons must be Members of the Society, and all Special Committees shall be under the control of the Council. The President for the year shall be the Chairman of all Special Committees, and the General Secretary of the Society shall be the Secretary of them, unless otherwise arranged by the Council.

33. No Special Committee, nor any Committee of Local Section shall have any control over the funds of the Society, except to the extent to which funds for its use may be voted by the Council. An account of the manner in which any funds so voted for the use of any Committee have been expended shall be furnished to the Council on or before the 31st of December in each year.

34. An Annual General Meeting of the Members of the Society shall be held at such time and place as shall have been decided at the previous Annual General Meeting, to receive a Report from the Council, to elect office-bearers, to hear an address by the President, and to transact such other business as may be necessary or desirable, including, if the Council think fit, the reading and discussion of papers.

35. Notice of each Annual General Meeting shall be given in the Journal of the Society at least fourteen days before the day on which such Meeting is to commence.

36. The order of the business to be transacted at the Annual General Meetings shall be decided by the Council from time to time.

37. A Member may introduce one visitor at any General or Local Meeting of the Society. Such visitor may, by leave of the Chairman, take part in any discussion, but he shall not vote.

38. The Council may accept communications from gentlemen not Members of the Society, and allow them to be read before the Members.

MISCELLANEOUS.

39. If any person proposed to the Council for election as a Member of the Society be rejected, no record of his rejection shall be placed upon the minutes.

40. All papers proposed to be read before a General Meeting of the Society must be sent to the General Secretary fourteen days at least before the date of that Meeting. The Council shall allow them to be read or ask that they be amended, or reject them, as it thinks fit.

41. The Society shall have the right of priority of publication for three months of all communications made to the Society.

42. A Journal of the Society shall be published at least once a month, and shall be distributed gratuitously to the Members of the Society, except that no Member of the Society shall be entitled to receive it who has not paid his subscription.

43. The author of any communication which has been read before the Society or before any of its Local Sections, and the publication of which in the Society's Journal has been authorised by the Council, may receive not more than fifty copies of such communication, together with the discussion thereon, if the author desires it, printed separately, provided that he gives notice of his desire to receive such copies upon the manuscript of his communication forwarded by him to the Editor of the Journal.

44. The Journal of the Society shall be edited and managed as the Council shall prescribe from time to time. Nothing shall appear in it, the publication of which has not been authorised by the Council, or by a Publication Committee appointed by the Council. It shall contain, in full or in abstract, as the Council may in each case decide, such of the communications read before the Society or any of its Local Sections as the Council may consider it desirable to publish, together with such other matter, relating to applied chemistry and the practice thereof, as the Council may from time to time direct.

LOCAL SECTIONS.

45. Upon receiving a requisition signed by at least thirty Members of the Society from any particular district, the Council shall consider the advisability of allowing a Local Section for that district to be formed.

46. Each Local Section may make rules for its own government, but no such rules shall be valid unless and until they have been sanctioned by the Council of the Society, and such rules must in each case include the following provisions :—

(a) That the affairs of the Section shall be conducted by a Committee, which shall be elected by the Members of the Section, in such manner as the rules of the Section shall provide.

(b) That, except elections to fill up unforeseen vacancies, all elections to the Committee of a Local Section, and all election of Officers of the Section, whether such Officers be appointed by the Committee or otherwise, shall take place in the month of April, and that the names of the persons elected shall in each case be reported to the Council on or before the 20th of that month; but that the Members of Committee and the Officers thus elected or appointed in April shall not take office, and those whom they are to succeed shall not retire from office, in each case until the close of the session then current.

(c) That no modification of or addition to the rules of the Section shall be made without the consent of the Council of the Society.

47. When the Council has consented to the formation of a Local Section of the Society, and has approved the rules by which it is proposed that that Section shall be governed, the Chairman and Honorary Secretary of that Section shall be *ex-officio* Members of the Council of the Society.

48. Each Local Section shall be bound to defray its own expenses for printing, stationery, advertising, postage, reporting, and hire of rooms; but the Council shall make a grant in aid thereof out of the General Funds of the Society, or may, if it think fit, defray the whole thereof.

49. An account of the expenditure of each Local Section during the preceding twelve months shall be furnished to the Council on or before the 15th of June in each year.

50. Except for printing, stationery, advertising, reporting, postage, and hire of rooms, no Local Section shall incur any expense without having previously obtained the sanction of the Council thereto.

51. For the purpose of meeting its expenses, each Local Section may require its Members to pay a Sectional subscription, which, however, shall not exceed Five Shillings per annum.

52. Every Member of the Society shall be entitled to attend, and to take part in the proceedings of the meetings of all Local Sections, except meetings concerning the business management of any Section of which he is not a Member.

53. The Committees of Local Sections shall have power to accept or reject communications proposed to be read before such Sections.

ALTERATION OF THE BYE-LAWS.

54. Any Member of the Council may submit to the Council in writing any proposal to alter or add to the present Bye-laws, and the Council may submit such proposal to the ensuing Annual General Meeting, if it think fit; but the Council shall submit such proposal to such Annual General Meeting, on a requisition to that effect, signed by at least Twenty Members of the Society, who are not in arrear with their subscriptions, provided that no proposed alterations of, or additions to the Bye-laws shall be considered at any Annual General Meeting, unless at least one month's notice thereof has been posted to every Member of the Society.

EXTRAORDINARY MEETINGS.

55. Extraordinary General Meetings of the Society may be convened at any time by the President and Council, or on receipt of a written requisition, signed by at least Thirty Members of the Society. The circular calling the Meeting must state the objects thereof, and must be delivered or sent by post to each Member of the Society at least fourteen days before the proposed Meeting is to take place.

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THE JOURNAL OF THE Society of Chemical Industry:

A MONTHLY RECORD

FOR ALL INTERESTED IN CHEMICAL MANUFACTURES.

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FRIDAY, Jan. 22nd	WED., June 23rd
TUESDAY, Feb. 23rd	FRIDAY, July 23rd
TUESDAY, March 23rd	FRIDAY, Oct. 22nd
*WED., April 21st	TUESDAY, Nov. 23rd
MONDAY, May 24th	THURSDAY, Dec. 23rd

At 5 p.m.

* To avoid interference with Easter Recess.

N.B.—There will also be a meeting of Council on the first day of the annual meeting at Liverpool in the early part of July.

PROSPECTIVE DATES OF MEETINGS OF PUBLICATION COMMITTEE, 1886.

FRIDAY, Jan. 22nd	FRIDAY, July 23rd
TUESDAY, Feb. 23rd	MONDAY, Aug. 23rd
TUESDAY, March 23rd	THURSDAY, Sept. 23rd
*WED., April 21st	FRIDAY, Oct. 22nd
MONDAY, May 24th	TUESDAY, Nov. 23rd
WED., June 23rd	THURSDAY, Dec. 23rd

At 3.30 p.m.

* To avoid interference with Easter Recess.

NOTICE.

The supply of copies of the Journal for January, 1882, being now exhausted, the Secretary would be glad to receive communications from members possessing extra copies of that number, in good condition, with a view to purchase.

Should sufficient applications for complete sets be received, the number will be reprinted.

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Thomas Rowley, 9, Conyngham Road, Victoria Park, Manchester, expert on indiarubber.

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Alfred Smith, Bank Lane Chemical Works, Clayton, Manchester, drysalter.

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George Walker, City Analyst's Laboratory, 138, Bath Street, Glasgow, chemist.

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George Wilton, Gasworks, Silvertown, E., tar distiller.

John Wilson, Redheugh Chemical Works, Gateshead-on-Tyne, chemist.

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MEETINGS, SESSION 1885-86.—First Monday in each month (unless otherwise indicated).

ORDINARY MEETINGS.

First Monday in the Month, at 8 p.m.

February 1.—Mr. Gustav Bischof—"Notes on Dr. Koch's Water Test." Mr. J. W. Westmorland, A.R.S.M.—"The Estimation and Valuation of Copper Ores and Products for Commercial Purposes."

March 1.—Mr. Boyerton Redwood, F.I.C.—"Viscosimetry." Mr. T. B. Lightfoot, M.I.C.E., M.I.M.E.—"Ice Making and Cooling Machinery."

April 5.—Professor Unwin, M.I.C.E.—"The Principles and Methods of Testing Cementing Materials." This meeting will be held in the Central Institute, City and Guilds of London Institute, Exhibition Road, South Kensington.

May 3.—Mr. A. G. Salamon—"Purification of Water." Messrs. Macnab and Beckett—"The Treatment of Water for Technical Purposes."

June 7.—Dr. Meymott Tidy—"Chemical Treatment of Sewage."

July.—Annual Meeting at Liverpool.
Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held Monday, January 4, 1885.

MR. D. HOWARD IN THE CHAIR.

ON THE ENRICHMENT OF COAL-GAS BY CERTAIN HYDROCARBONS.

BY GEORGE E. DAVIS.

EVER since the introduction of illumination by means of coal-gas, various processes have been put forward and patented, having for their object the enrichment of the gas with certain hydrocarbons. One by one have these processes appeared, and as certainly have they disappeared, so that there remains but the bare record of their existence, and, strange to say, there does not appear, in the literature devoted to the subject, any rational ideas of the why and wherefore of the failures of the different processes which have been from time to time devised.

If we go back to the earliest records of gas-lighting, we shall find that the tar produced in the operation of the manufacture of gas proved in those days to be an article very difficult of sale, and many efforts of a

crude nature were made to turn it into gas. In a pamphlet published by Mr. Clegg in 1820, a circular oven was described for carbonising coal, in which a pipe was fixed near to the mouth of the oven, so contrived that the tar, as it was condensed, returned upon trays, and was thereupon converted into gas. Mr. John Grafton (a pupil of Mr. Clegg's), about this time also sought to convert the tar into gas, and in one of his patented settings the retorts were placed in an inclined position, and a secondary retort added for the purpose of receiving the tar and converting it into gas. This idea was never probably worked at with a view of enriching ordinary coal-gas, but was most likely adopted as a means of getting rid of a very noxious and inconvenient by-product, for in those days the expedient of utilising it as fuel was not thought of.

Supposing for a moment that these crude attempts, and others of a similar nature which followed them, had been successful in the matter of gas making, pure and simple, it is doubtful how far they would have conduced to the enrichment of the gas, as I have found by experiment that the pitch which constitutes about three-fifths of the total weight of the tar produces a gas absolutely devoid of illuminating power, in quantity about 25 per cent. of its weight, and the accumulation of naphthalin and of heavy oils in the process would militate against successful working.

At an early date, however, many processes were devised by Ibbotson, Donovan, Selligie, Sanders, Manby, Val Marino, White and others, having the idea in view to enrich ordinary coal-gas with the vapours of certain hydrocarbons, or to impregnate non-illuminating gases with these vapours so that the resulting gas might be used for purposes of illumination. All these processes have sunk into oblivion in this country, for one very good commercial reason,—there is no cheaper raw material than coal upon which to operate, nor is there any other substance extant which will give as a basis, by simple destructive distillation, ten thousand cubic feet of gas per ton of coal, of an illuminating power equal to seventeen candles, at the same price as coal.

In many places seventeen candles' illuminating power is all that is required, and when an Act of Parliament stipulates for more than this, coal again, of a richer quality, in the shape of cannel, is almost universally employed. Any substance, then, for enriching gas, must be able to compete financially with cannel coal.

But supposing we are satisfied with the gas first, I believe, devised by Mr. C. Ibbotson, in 1826, produced by passing steam through red-hot coke, the question is whether it is possible to impregnate such a gas with the vapours of volatile liquids more perfectly and more cheaply than can be done during the process of manufacturing ordinary coal-gas in the usual manner. I think the able paper of Mr. Lewis T. Wright, read before the Manchester Section of this Society, on December 4th, 1883, answers this question in the direct negative. To attempt the carburation of gas by employing any compound of the benzene series seems to me the height of absurdity, seeing that it is from coal-tar that these products are produced, and the cost of extraction must be added to the original cost of the tar. If these compounds are to be used at all, it is the crude tar which should be operated upon in the gas-works, the tar being made to replace cannel.

In 1832, Lowe introduced his system of naphthalising gas specially devised for enriching a poor coal-gas, in order to make it equal in illuminating power to that produced from cannel coal. The original idea was to use the wet gas-meter as the carburetter, filling

it with the light spirit obtained from coal-tar; but it was soon found to be too costly, to require too much attention, and altogether unsuited for universal application. The principle here advocated by Mr. Lowe has been the favoured ground for inventors for many years, but I hope to show the apparent impossibility of its practical attainment, under present circumstances at any rate.

If inventors, however, have been discouraged by the high and varying prices of volatile members of the benzene series of hydrocarbons, those of the paraffin series (extracted from American petroleum) have been open to them, yet with gasoline at sixpence half-penny per gallon, it is very doubtful whether this method would be able to hold its own financially against enrichment by cannel in the usual way. In many places, both for public and private lighting, the system of carburetting gas by impregnating it with the vapours of hydrocarbons has been in use over long periods, and from the experience gained, it has come to be a recognised fact that, if carburetting is practised at all, it must either be effected at the burner itself, or, if the gas is carburetted at the gas-works, it must undergo some special treatment in order to make the illuminants carry to the end of their destination.

Carburetting at the burners with liquid hydrocarbons does not, I think, require serious consideration, although I am told it is in operation in the corridors of the Manchester Exchange, and also at the St. Pancras Station in this city. The replenishing of the reservoir with liquid for each burner would certainly not be practised for long in any domestic establishment, and for any service of public lighting the method would not be likely to find favour with the attendants on account of the extra work it would entail. The liquid used in the two places already cited is good fluid creosote oil, and this at twopence per gallon is economical. In order to enable the benzene series of hydrocarbons to be used for carburetting, coal-tar would have to be reckoned as of no value whatever, and, indeed, with the present price of 90's benzol—viz., 1s. 11d. per gallon—it is very certain that many gas-works would do better by using the tar as fuel for heating the retorts or for carburetting the gas, than by selling it; there are indications now of it being used as fuel in some quarters. Properly applied as a fuel, one cwt. of coal-tar will do as much work as two cwt. of coke; so that there is not much chance of seeing benzol at such a price as will enable it to be used for carburetting.

When a gas is carburetted at the works (as, for instance, in America, where water-gas is made on the large scale), the mixture of carbonic oxide and hydrogen, after saturation with the hydrocarbon vapours, is passed through heated retorts, to "fix the carbon," as it is termed, as petroleum spirit is commonly supposed to possess less "carrying power" than the illuminants of ordinary coal-gas. There is no doubt that the process of heating does "fix the carbon"; but the reason must be sought in another direction than that usually indicated. The following table shows the vapour tensions of pure benzene and of gasoline, and it would appear, therefore, that the latter should have much more carrying power than the former:—

Deg. Cent.	Pure Benzene.	Gasoline.
-10°	13.4	43.5
0	26.6	81.0
+10	46.6	132.0
20	76.3	203.0
40	182.0	301.8

In cases of this kind, however, we must also remember that the nature of the gas itself into which the vapour diffuses exercises a very decided action upon the rate of evaporation. Coal-gas is more active

than air, in the proportion of 1.5 : 1; whilst hydrogen is nearly 3.5 times as active as air; so that, in practice, an apparatus for carburetting air would have to be of 3.5 larger capacity than one for carburetting a similar volume of hydrogen in a given time.

In order to be in a position to follow the experiments described farther on, and to judge of the feasibility of carburetting various gases with the vapours of volatile liquids, it will be as well to cast a glance at the composition of coal-gas generally. It must not be supposed that gas from coal possesses any exact composition. The proportions of its constituents are, however, fairly uniform; and it may be taken for granted that, when made from a good quality of ordinary gas-coal, it will contain about forty-six per cent. of hydrogen and thirty-four per cent. of methane (marsh gas), with about eight per cent. of carbonic oxide, and small quantities of nitrogen and carbonic acid. This is the vehicle or "carrier," and is permeated by those vapours of hydrocarbons which give it its illuminating power. These illuminants were generally stated as consisting almost entirely of olefiant gas; and, later, of benzene, propylene, and ethylene. In several recent analyses, the last-named gas is stated to occur to the extent of 2.5 per cent. by volume. Whether or not this is correct demands further investigation; but I am inclined to think there is much less ethylene in coal-gas than is usually stated, and in some varieties of gas it is doubtful whether it exists at all. With regard to the aromatic series of hydrocarbons, it is certain that these illuminants in coal-gas do not consist of benzene simply with a vapour tension equal to that shown in the foregoing table. They consist of the vapours of hydrocarbons boiling below the point of ebullition of pure benzene itself to that of pseudocumene and mesitylene, or from 80° C. to 160° C. and the vapour tension of this mixture of hydrocarbons is far less than that of benzene itself; so that ordinary coal-gas is much more nearly saturated with vapours than most persons imagine.

The vapours of the volatile hydrocarbons present in coal-gas may be easily extracted by passing the gas through olive oil; the liquid hydrocarbons being displaced and collected by blowing steam through the saturated oil. It is possible by these means to extract from three to four gallons of liquid hydrocarbons from 10,000 cubic feet of ordinary coal-gas, according to the temperature employed; the illuminating power of the gas being reduced accordingly. In order to ascertain the composition of the vapours made at medium and high temperatures, I passed a large quantity of gas through olive oil, regained the liquid hydrocarbons, and separated them roughly by means of Le Bel and Heninger's fractioning tubes with the following results:—

	Medium Heats. High Heats.	
Hydrocarbons extracted	gallons 4	3.2
Illuminating power of gas before extraction.....	candles 19	17
Do. do. after extraction ..	" 8	8

Boiling Point of Hydrocarbons.	Per cent.	Per cent.
Below 80° C.	2.0	1.2
80—83	53.0	50.1
90—100	3.6	2.5
108—113	21.0	27.9
116—128	3.2	2.1
135—140	8.1	11.2
145—150	2.0	2.0
150—160	3.3	1.7
Above 160	3.8	1.3
	100.0	100.0

Cannel gas, having an illuminating power of twenty-seven candles, was also passed through olive oil, with the result of obtaining only 2.9 gallons of liquid

hydrocarbons; reducing the illuminating power of the gas to nineteen candles. This liquid distilled as follows:—

	Per cent.		Per cent.
Below 23° C.	12.0	90—100° C.	8.3
30—35	1.5	100—108	4.0
35—73	5.2	108—113	7.1
73—78	11.2	116—140	2.4
80—83	41.0	140—160	0.8
85—90	5.0	Above 160	1.5

It will be seen from the above that the nature of the hydrocarbon vapours present in cannel gas is substantially different from those in coal-gas. The vapours given off below 23° C. required condensation in ice and salt, and were doubtless those of crotonylene. They were brominated, and the bromo compound further examined.

These experiments seem to point to the fact that if it is desired to increase the illuminating power of coal-gas to that of cannel, the benzene series of hydrocarbons must not be exclusively employed. A certain amount of them may be necessary; but to do it in the way ordinarily proposed would be ruinous in cost. Experiment has shown that the extraction of one gallon of liquid from 10,000 cubic feet of the gas reduces the illuminating power about three candles; so it is fair to presume that the addition of one gallon will increase it by that amount. Every three candles (if carburetted with 90% benzol—the lowest quality permissible) would, therefore, cost 1s. 8d. per 10,000 cubic feet. But I shall presently show that this is only a mythical figure, as a reaction takes place (not observed before, I believe) which militates against the success of any process of carburation which depends upon the vapourisation of a heterogeneous fluid by the passage of a mixed gas through it, already nearly saturated with vapours of varying vapour tension.

In processes of carburation by the above system, a good "solvent naphtha" has been the usual substance employed. Dr. Letheby's specification for carburetting naphtha stipulated for a quality distilling seventy per cent. at 130° C., and ninety per cent. at 150° C. I have made many experiments with naphtha of this quality, and find that, at a temperature of 20° C., 10,000 cubic feet may be made to absorb and exchange about 3.25 gallons of the light portion, and after a little while scarcely anything is vapourised. With 50/90 benzol, at 20° C., 10,000 cubic feet will take up about 7.75 gallons, and at 15° C. about four gallons of the lighter portions; while with ninety per cent. benzol, at 20° C., 10,000 cubic feet will absorb and exchange about fifteen gallons. Were it not for the ruinous cost of ninety per cent. benzol for such a process, no doubt it might be successfully applied, now that we know more about the principles which govern carburation, and provided a market could be found, at a reasonable price, for the less volatile portion.

In the experiments just quoted, the apparatus was fed plentifully with the various carburetting agents; but experience soon showed that the quantity taken up became less and less as the benzene evaporated—50/90 benzol testing fifty per cent. at 100° C., and ninety-two per cent., at 120° C. after being evaporated to about one-third tested, the first drop distilled at 103° C., twenty-four per cent. at 110° C., and fifty-six per cent. at 120° C. Solvent naphtha, which showed on distillation thirty-five per cent. at 120° C., seventy per cent. at 130° C., and ninety per cent. at 150° C., yielded after passage of the gas (during which only 1-16th of the liquid had evaporated) twenty-eight per cent. at 130° C., and seventy-nine per cent. at 150° C. With ninety per cent. benzol, which tested ninety-one per cent. at 100° C., and a dry flask at 118° C., a residue was left when

only one-fourth of the liquid had evaporated, testing seventy-nine per cent. at 100° C., and ninety-two per cent. at 120° C. I found also that this happens when gasoline is employed as the carburetting agent. A great deal of this information (but without quantities being given) has been recorded by older observers. Hughes, in his "Treatise on Gas Works," states:—"The main difficulty existing against the carburisation of gas is the irregular evaporation of the fluid; a portion of which, when placed in the carburating vessel, is remarkably volatile, and passes off in abundance, requiring burners with very small holes to prevent the formation of smoke. By degrees, when the most volatile vapours have evaporated (the gas, in consequence, not being enriched), a difficulty arises from the smallness of the burners."

Carrying the above investigation further, I found that the residual spirit from carburetting contained in absolute quantities more toluene, xylene, pseudocumene, and mesitylene than entered into the composition of the original fluid. The only way in which I could account for this was by supposing that the gas, in taking up benzene vapour, had deposited the heavier hydrocarbons of less vapour tension to make room for it. This surmise was found to be correct. I passed a large quantity of seventeen-candle gas through pure benzene (boiling between 80.5° C. and 80.8° C.), until the volume of the carburetting fluid was reduced to one-fifth. The residual spirit now distilled only eighty per cent. at 100° C., and ninety-three per cent. at 120° C., proving beyond doubt that toluene, xylene, and the higher hydrocarbons, had been deposited from the gas. I carried out the same experiment with gasoline, and found that the aromatic hydrocarbons were also deposited amongst the residual fluid to quite as great an extent as when using ninety per cent. benzol as the carburetting fluid. Of course, it would be possible to contrive a carburetting apparatus fed with a continuous stream of the enriching fluid, so that while ninety per cent. benzol was entering the apparatus, a constant outflow of toluene or solvent naphtha would take place. I have arranged a small apparatus on this plan; but the results obtained with it have assured me that the process would not be commercially successful. The late Mr. T. Collinge (with whom I have made many experiments), when chemist to the Air Gas Company, of London, found that 1200 cubic feet of air gas, when made of sixteen-candle power, contained the vapour of four gallons of gasoline, which is as near to the saturation point of a practical temperature as it is possible to work, as, if cooled to 0° C., some of the heavier hydrocarbons were sure to be deposited. I have come to the conclusion, also, that the vapours of the paraffin series of hydrocarbons have, volume for volume, or weight for weight, much less illuminating power than those of the aromatic series. The above experiment with air gas seems to point to this; but as the presence of air is found to interfere seriously with the illuminating power of coal-gas, it is only fair to assume that it would also injuriously affect the quality of the air gas, of which it constitutes ninety per cent. Mr. W. Lyon, however, has placed on record an experiment which would tend to prove the truth of my supposition. The experiment is given in detail in "King's Treatise on Coal-Gas," vol. iii. p. 355. A thousand feet of seventeen-candle coal-gas, by the absorption of 127 gallons of gasoline, became 1270 cubic feet of 38.83 illuminating power; or 2.5 candles produced in 1000 cubic feet by each gallon of the carburetting fluid. Compare this with the enrichment produced by the use of the benzene series: 1000 cubic feet of good coal-gas will give up 0.3 gallon of liquid hydrocarbons in losing about nine candles illuminating power, or three candles per

gallon per 10,000 cubic feet. I must confess I have never (at the ordinary temperature of 15.5° C.) been able to saturate coal-gas with as much gasoline as Mr. Lyon succeeded in doing. The utmost quantity I have succeeded in making 1000 cubic feet of coal-gas hold at 15.5° C. has been two gallons; so without doubt Mr. Lyon used a more volatile sample than I did, and it probably contained a less percentage of the heavier hydrocarbons. From these experiments it will be readily seen that carburisation in this way, even if it were practically possible, would never pay as a process of enrichment.

I do not think the subject of the mixing of vapours having very great differences of vapour tension has been studied sufficiently in connection with the manufacture of coal-gas. If it had, there would have been fewer attempts at carburisation in the direction already indicated; and other phenomena, seemingly inexplicable, would have been readily explained. In "King's Treatise on Coal-Gas" (*loc. cit.*), it is stated: "At Lowell, Massachusetts, the naphtha gas, after being measured, was passed into the hydraulic main of the coal-gas, with which it was washed and purified. The object of mixing the gases at this point is not clear, except it be with the idea of effecting a thorough amalgamation of the compound in the course of its subsequent treatment."

There is no doubt that by this method the illuminating power of the gas would be more permanent, in consequence of time and opportunity being given for the vapours of high tension to dislodge and occupy the place of those of low tension, and thus be able to withstand greater variations of temperature without the tendency to precipitate any illuminant in the liquid form.

It was not my intention at the outset to speak of any method of enrichment by means of solid hydrocarbons; but perhaps the method of carburisation known as the albo-carbon light deserves to be noticed. Upon ordinary gas-lights it may, perhaps, be difficult to assure a casual observer of the efficiency and economy of this principle; but with 9-candle gas there is no difficulty whatever. Most of you will be aware that at the Rockingham Gas Works, where my process for the extraction of benzene from the gas is in operation, the residual gas is quite unfit for purposes of illumination. After extracting about 4 gallons of liquid hydrocarbons per 10,000 cubic feet of the gas, this debenzolised gas has to be burnt from one of Bray's "market" burners in order to illuminate a room 10 feet square, and that not very satisfactorily. By employing the albo-carbon light, the illuminating power is with ease brought up to 20 candles, and the gas consumption reduced from 23 to about 3½ cubic feet per hour. I think the albo-carbon system deserving of great extension, though I am doubtful whether the average householder is sufficiently regardful of his purse to undergo the extra labour of charging the apparatus periodically with the necessary naphthalene.

I must now return to the subject mentioned in the early part of this paper—viz., the conversion of the tar into gas, and a method of using this gas for enriching the principal portion; as, if it could be effected satisfactorily, I believe it would bring a greater revenue to the gas companies than by selling the tar at such ridiculously low prices as some of them are at present obtaining. Tar is slowly but assuredly increasing in quantity, though means might be adopted in the gas-works whereby a large percentage might be curtailed. Low temperatures, with 9000 cubic feet of gas per ton, will yield, with some coals, 16 gallons of tar; whilst high temperatures will yield but 9 gallons, with about 11,000 cubic feet of gas. Now, if in every gas-works, they would in

this way curtail the supply of tar, they would be reducing the production of the United Kingdom by about 30 per cent., which would not fail to have an effect on prices, both of benzol and of pitch, which are now extremely low, and will not rise unless the supply of tar is diminished. Then, again, instead of selling tar, it can be made to replace the cannel coal, now almost universally employed for increasing the illuminating power of ordinary gas. I have already attempted to show that the gaseous illuminants of gas made from cannel coal are quite different to those existing in coal-gas; and coal-tar can, by proper treatment, be made as valuable to the gas maker as the best cannel coal.

In the early days of gas making, the attempts to gasify tar were of a very crude nature. It was run into retorts, there to be reheated, or on to trays placed inside them, with the result that every pipe and outlet became speedily choked with pitch. The nature of tar is now more completely understood, and some of us may be able to avoid the mistakes into which early operators fell. There are, in tar, three substances of no use to the manufacturer of gas intended for illuminating purposes—viz., pitch, naphthalene, and anthracene; and unless these are extracted before treatment, they become his *bêtes noires*. The process I am now about to advocate depends upon the elimination of these three products from the tar, and the conversion of the remainder into gas. The boiling point of anthracene is so high that the heat of the retorts has very little action upon it, unless the heat is raised too high; in which case viscid oils are produced, which tend to choke up the apparatus. Naphthalene is exceedingly difficult to deal with. It volatilises in a great measure, and chokes up the condenser and other cool portions of the apparatus; while another portion is changed into di-naphthyl and iso-dinaphthyl, which are of no use to the gas maker. Pitch, when carbonised, yields only about 25 per cent. of volatile matter, nearly entirely gas of no light-giving value whatever; and, of course, if this gas were mixed with that from the coal, it would much dilute its illuminating power.

It is well known that light oils from gas-tar, petroleum spirit, petroleum residues, creosote, heavy oils from gas-tar, etc., become gasified to a great extent by heating to redness, or by passing over red-hot surfaces, and about 80 cubic feet of 50-candle gas thereby obtained per gallon, possessing a specific gravity of '912, which, with oils weighing 10·8 lb. to the gallon, is equal to 16,600 cubic feet of 50-candle gas per ton. Now, this rich gas approaches more nearly the composition of rich cannel gas, than that made from any other substance. The greatest illumination is produced from the formation of very low-boiling hydrocarbons of great vapour tension, such as crotonylene (C_4H_6), which I have often separated in large quantities; and to these the illuminating power is principally due. Thorpe and Young (*Ann. Chem. Pharm.* clxv. 1) found that solid paraffin, by heating under pressure, is resolved into a mixture of liquid products consisting essentially of low-boiling paraffins, and medium and high-boiling paraffins and olefines; and there is but little doubt that some reaction or decomposition of this nature takes place when the vapours of the coal-tar oils are passed through a red-hot retort.

In order to carry out this process of enrichment upon a practical scale (say for works carbonising 50 tons of coal per day), a set of three 10-ton tar-stills would have to be provided, so that they might be worked in sequence, one always being run off and refilled.

The raw tar is distilled in the usual manner, and the distillate conveyed into three separate tanks, A,

B, and C; the still being stopped when a sample of the pitch, on being withdrawn, twists easily at a temperature of 55° C., and when thus made it is of an extremely good quality, and commands a ready sale. The contents of tank A will remain liquid, naphthalene will separate from tank B on cooling, and anthracene from tank C. If tank B is constructed in the form of a filter, the naphthalene can be easily removed from the process, and either worked up, sold, or used as fuel. The oils in tank C must be filter-pressed, to remove the anthracene; after which the contents of all are ready to be made into gas. When sufficient oils have accumulated, another of the stills is filled with a mixture from the tanks A and B, and the whole slowly distilled; the vapours being passed directly into one end of a through retort heated to dull redness, the gasified hydrocarbons passing out at the other end by means of the ascension pipe, and mixing with the gas from the ordinary retorts. When four-fifths of the contents of the still have been vaporised, the fire is withdrawn and the still filled up with raw tar, which is distilled as before, and the pitch run out for sale; after which, the still is again ready for vaporising another batch of oils. When sufficient filtrate from the anthracene has accumulated, it is distilled in whichever still happens to be at liberty. The first fourth is run to the creosote or B tank, the second fourth into the anthracene or C tank; the still being stopped when the pitch will just soften at 50° C., when it is run off into the pitch-house in the same manner as when dealing with ordinary tar. The whole process is so simple that any intelligent lad might work it. It does not depend upon any complicated chemical tests; a thermometer and a hydrometer being the only apparatus required. In this way every gas-works would be able to supply an illuminating gas of good quality without the aid of cannel coal, and to be producers also of pitch and anthracene of the very best qualities, with which no one could ever think of competing.

In conclusion, let us see how this would affect the illuminating power of the gas made by this process.

In the case of coal and cannel—

100 tons of ordinary coal give 10,000 feet of 17-candle gas.	
5 " cannel coal	12,000 " 28 "
Coal produce, 1000 @ 17 candles	17,000
Cannel " 60 @ 28 "	1,680

In all 1060 @ 17·6 candles.

Taking coal and gas-tar—

100 tons of coal give 10,000 feet of 17-candle gas.	
2·8 " tar oils	16,600 " 50 "
Coal produce, 1000 @ 17 candles	17,000
Tar oils " 48·5 @ 50 "	2,325

In all 1046·5 @ 18·1 candles.

In these calculations, I have taken 12 gallons of tar to be the produce from a ton of coal. If more tar is produced than this, the comparison will, of course, be more favourable. I have not gone to the length of calculating out the results according to the price of cannel, which must vary in every locality according to the cost of carriage; but I have endeavoured to show that the 7 tons of tar produced from 100 tons of coal is of value to the gas maker equal to nearly 10 tons of cannel coal. It therefore seems to me to be the height of absurdity to let the tar go away from the gas-works at some of the very low prices at present ruling; and, moreover, I have not reckoned in the values of the pitch and anthracene which would also be produced. One through retort will give about 500 cubic feet of gas per hour, besides a certain quantity of tar and ammoniacal liquor. This is equal to the decomposition of some 7 gallons of oil per hour.

In order to prevent misunderstanding, I may add that the process is patented, and I hope soon to see it at work.

DISCUSSION.

The CHAIRMAN said that the whole question of the enrichment of coal-gas by hydrocarbons needed much more scientific and systematic treatment than it had yet received. In some respects the methods in use were crude, and required always intelligent attention to produce satisfactory results. Mr. Davis's contribution to the solution of the question was interesting, and it appeared to him that the technical problem of producing gas of a high illuminating power and a more complete utilisation of the products of coal distillation had received an intelligent contribution to its solution by the author.

MR. FENNER said he understood Mr. Davis's idea to be that producers of coal-tar should utilise it for the re-production of gas, but it occurred to him that Mr. Davis had rather omitted to deal with anthracene and other hydrocarbons which were obtained. He would ask Mr. Davis whether the curious product chrysene had been utilised? He questioned, looking at the amount that gas-works obtained for their coal-tar, whether, if they were simply to convert it into gas, they would realise as much as now. If this idea were carried out, they might also not only become coal-tar distillers, but anthracene refiners, and perhaps in the future alizarin manufacturers.

Mr. MACKINNON said he had been engaged for the last three years in the very interesting problem of enriching coal-gas. He had been endeavouring to hit on the proper hydrocarbons to enrich coal-gas direct either by supplying it at the burner, or by passing the gas through a carburetter. He had tried a large number of hydrocarbons with various effects, and with regard to benzol he had observed the very curious fact which Mr. Davis had alluded to, that the illuminating power at the commencement was great, and then gradually diminished. If his surmise was correct, that benzol (commercial) was composed of three separate hydrocarbons, benzene, toluene, and xylene, he could believe that these hydrocarbons were absorbed by the gas in the order given. Some of the results he had obtained were as follows:—With a sample of 90 per cent. benzol, specific gravity 870·6, charge consumed 4469 grains, time occupied 52 hours 50 minutes, gas burnt 179 cubic feet, time for 1000 cubic feet 285 hours 10 minutes, residue left in carburetter, none. At the time the experiments were made the cost of benzol per gallon was 8s., it was now reduced to 1s. 11d. The total charge experimented upon was 5000 grains, and the weight 4353 grains; 1000 cubic feet of gas required 24,970 grains of the benzol, equal to ·403 of a gallon; the cost came to 3s. 4d. at 8s. a gallon. Total candles 3276; excess candles due to hydrocarbons 1026; excess of candles in cubic foot 456. The actual cost was 1s. 5d. A large number of experiments were made employing various hydrocarbons—for instance, a mixture of benzol, toluol, benzene and gasolene; also coal-tar distilled with naphtha and shale spirit. With the distillate of naphtha he obtained no less an increase than 6552 candles, whereas with benzol it was 3276. That convinced him that a distillate of naphtha might be found which would answer all purposes for enriching coal-gas, but in this case there remained a very large sediment of 696 grains unabsorbed by the gas, and, therefore, it was probable that the distillation should have been stopped at an earlier stage. The difficulty was to get each hydrocarbon of specific gravity, not mixtures as now. Benzol (commercial) was supposed to be composed of three different substances, but his impression was that it was composed of a much larger number, which had not yet been isolated, every one of which required a different degree of heat to volatilise, and the difficulty was to stop the process at the proper moment to get one uniform hydrocar-

bon, then uniform results could be obtained. Commencing with, say eighteen candles, employing a burner consuming three cubic feet, at the end of the consumption of the hydrocarbon you would have the same result ; but at the present, you commenced with eighteen or twenty candles and gradually went down to five or six. Mr. Mackinnon regretted that he could not take up more time in this matter.

Mr. Davis, in reply to Mr. Fenner, said he had mentioned that in the distillation of the coal-tar as it came from the ordinary hydraulic main one-third portion of the distillate was to run into tank called C. The anthracene was separated from that tank, and was hydraulically pressed for sale. The oils expressed from the anthracene contained some of the chrysene. Some would be sold with the anthracene, and the remainder go away with the pitch. With regard to the suggestion that these portions could not be carried out under the present Acts of Parliament, it need only be pointed out that a great many gas-works do now distil their own tars in both London and the provinces. The question was, however, whether tar would produce as much value when used instead of cannel coal as when sold in open market, and he had tried to show that seven tons of tar might be made equal to ten tons of cannel coal. It was, therefore, very easy without elaborate calculation to find out what tar should be sold at the various works. Mr. Mackinnon stated he had used ninety per cent. benzol for carburetting gas.* There was no doubt that ninety per cent. could be used if it were profitable, but from the solvent naphtha Dr. Letheby used there could be nothing but failure. Still, however, there is the gradual decrease in vaporisation to be got over even when using ninety per cent. benzol.

NOTES ON RUSSIAN TURPENTINE AND
ITS ATMOSPHERIC OXIDATION.

BY C. T. KINGZETT, F.I.C., F.C.S.,
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IN a paper communicated to this Society some three years ago by Dr. H. E. Armstrong,* attention was directed to the remarkable differences in the optical character of a number of samples of Russian turpentine; and from the rotatory powers then given in illustration of that fact, he infers that the proportions in which its two chief recognised constituents are present probably vary considerably, and that they are, perhaps, accompanied with other isomeric hydrocarbons.

I have found that not only do different samples of Russian turpentine present differences in optical character, but that they exhibit, also, equally striking differences in specific gravity and susceptibility to oxidation by air.[†]

For a long time I entertained the hope that a study of the physical properties of different samples, and the chemical history of their oxidation by air, would lead to the discovery of some simple relation between the results whereby the behaviour of any particular sample upon exposure to oxidation could be inferred beforehand. While, however, I have not been so fortunate in this respect as I had wished, the results seem to be of sufficient interest to warrant record.

Parcels of Russian turpentine bought direct from the importer, derived, it is believed, from a common

* Jour. Soc. Chem. Industry, 1882, p. 479.

† For a collective account of my investigations respecting the air oxidation of terpenes and allied substances, and the turpentine industry, see my book, "Nature's Hygiene," 2nd edition, chapters vi. and ix. (Baillière & Co.).

source, and obtained by the same distillation, are by no means uniform in quality; the contents of each barrel differ, as a rule, in one or more respects, from those of every other barrel. This variability in composition is, doubtless, attributable in the main to the method of distillation which is practised in Russia, but, in part, to the fact that the turpentine is not yielded by a single species of pine. Although the trees which are employed are chiefly the *Pinus sylvestris* and *Pinus ledbourii*, even they are not exclusively used; and as in the method of preparation the wood itself is subjected to distillation, it necessarily follows that at each stage of the process relatively different quantities of the several kinds will be undergoing both distillation and destructive distillation.

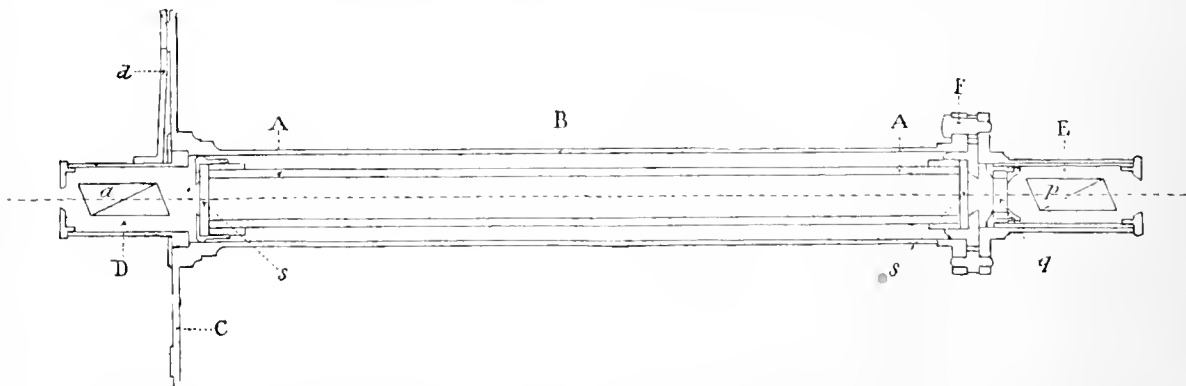
In the first place there is no evidence that the turpentines furnished by the *Pinus ledbourii* and other kinds of tree are identical with that obtained from the *Pinus sylvestris*. Further, there is reason to believe that the turpentine obtained from the different parts of a tree is not absolutely uniform in composition. For instance, Tilden* found that a sample of *Oleum foliorum Pini sylvestris* furnished upon fractionation two terpenes, one of which, smelling like ordinary American turpentine, boiled at 156° to 159° , but was more strongly dextrorotatory than australene (a column of 100mm. rotated the plane of polarisation $+18^{\circ} 48'$); whereas the other terpene

demonstrated the probable presence of furfurane (tetraphenol) and sylvane (C_4H_2OMe), a homologue of tetraphenol, in the low boiling portion of the wood oil obtained by the dry distillation of pine wood.†

Considering all these circumstances, it is not matter for surprise that Russian turpentine should, as found in commerce, present such want of uniformity in odour, colour, boiling point, specific gravity, optical behaviour and oxidisibility. Indeed, it would appear that the only method of obtaining an absolutely uniform turpentine oil (irrespective of kind) consists in the separative distillation (as distinct from destructive distillation) of one particular part of the trees belonging to a single species.

With reference to what follows, I should explain that it refers to manufacturing operations having for object the production of "Sanitas fluid" and "Sanitas oil," they being respectively the aqueous and oily products obtained by my process of air-oxidising turpentine in the presence of water at a temperature of about $60^{\circ} C$.

The results of the various experiments cannot be compared together, as the relative quantities of turpentine and water which were employed therein were not uniform, and the oxidation of the turpentine was not carried on for the same period in each experiment. In brief, the results attending the oxidation of any one sample of turpentine can only be compared with the results attending the oxidation of



boiled at 170° , but was levorotatory (per 100mm. = -4°), unlike sylvestrene (b. p. 171° to 171.5°), which is dextrorotatory (100mm. = $+17^{\circ}$). Tilden concluded, however, that it was sylvestrene, but this does not appear to be further proved. Later on, Atterberg† obtained from the oil extracted from the needles of *Pinus pumilio* a hydrocarbon which he also regards as identical with sylvestrene, but which exhibited rotatory power of -5.38 . The question arises, then, is this terpene, which resembles sylvestrene in its boiling point only (so far as yet proved), but which differs from it in its optical character, a distinct hydrocarbon?

Again, "pine cone oil," which is obtained by distilling with water the cones of *Abies pectinata*, differs in properties from "dwarf pine oil," which is similarly obtained from the young tops and cones of *Pinus pumilio*, while both of these oils are said to be dissimilar to "pine leaf oil," which is yielded by the leaves of *Pinus sylvestris*, or *Pinus abies*.

Lastly, the turpentine is undoubtedly accompanied with the products of destructive distillation of both rosin and the wood, including various hydrocarbons (cymene, benzene, toluene, xylene, paraffins, etc.), creosote, and tar and other acids. Atterberg has

other samples in the same series. In each series, however, the relative quantities of water and turpentine, the duration of the air-current, and the temperature at which the process was conducted, were as nearly identical as could be arranged upon the scale employed.

The rotatory powers (for columns of 200mm. of the turpentines used) in the first two series, were determined by Dr. H. E. Armstrong, as described in his paper to which reference has been made. In all the other series the reported rotatory values are merely the scale readings obtained upon examining layers of 200mm. in a "Portable Saccharimeter" (of Carl Zeiss of Jena, and supplied by Mr. Baker of London) by turning the rotating eye-piece until both semi-circles of the rock crystal plate acquired as nearly as possible the same reddish violet colour. I may, however, mention that two samples of American turpentine examined by this instrument gave the same scale reading of 23.5° .

The instrument consists of a glass tube, A, of exactly 200mm. in length, closed by parallel plates of glass, s s, at both ends, which is inserted into a brass tube, B. This brass tube carries a divided circle, C, divided by half-degrees, and upon this circle a shorter tube, D, rotates and contains a

* Journ. Chem. Soc. Trans. 1878, p. 83.

† Ibid. Abstracts, 1882, p. 410.

‡ Journ. Chem. Soc. Abstracts, 1880, p. 663.

Nicol prism, *a* (the analyser). The rotation of *D* is measured on the divided circle by means of an index pointer, *d*. The other end of *B* bears, by means of an eccentric pivot, *F*, a short tube *E*, with another Nicol prism, *p* (the polariser), and a double plate of rock crystal, *g*.

The amount of oxygen absorbed by the turpentine in each observation was calculated by multiplying the increase in its specific gravity, by the number of gallons of the product.

The peroxide of hydrogen observed in the aqueous solution does not represent the whole amount obtainable, but only the quantity actually present therein at the time of examination.

The amount of peroxide of hydrogen obtained per lb. of oxygen fixed in the oil of turpentine has been calculated in each instance by dividing the grammes H_2O_2 by the lbs. of oxygen absorbed.

SERIES I.

Rotatory Power, 200mm. Turpentine used.	Lbs. of Oxygen absorbed by the Turpentine.	Grms. H_2O_2 obtained.	Grms. H_2O_2 obtained per lb. O absorbed by Turpentine.
30.10	.96	125	130
31.20	2.52	385	151
32.27	1.87	255	136
32.27	7.50	324	43
32.50	3.00	232	77
31.80	3.15	264	84
36.18	7.75	417	53
36.40	5.94	463	78
37.50	5.83	630	108
39.44	7.15	992	138
39.52	5.81	635	120
39.58	3.75	477	127
40.42	5.04	802	159
42.10	3.96	904	228
41.11	3.24	422	130
46.45	5.83	621	106
38.26 (Bulked).	6.30	867	137
	5.28	650	123
	5.72	686	120
	3.60	473	131
	4.80	542	113
	3.84	394	103
	7.65	541	71
	6.75	403	60

I should remark, in respect of this series, that as no accurate record has been kept of the quantity of aqueous product, I have been obliged to assume that exactly the same quantity was obtained in all instances. The last eight cases in the series serve to illustrate the difficulty experienced in maintaining as many oxidisers under absolutely identical conditions. Nevertheless, it may be noted that the average quantity of peroxide of hydrogen obtained in these eight cases, where the same bulked turpentine was employed, was 107grms. per lb. oxygen absorbed by the turpentine, and this figure agrees somewhat nearly with the oil of nearest rotatory power in the preceding cases, in each of which, turpentine from separate barrels, was oxidised.

SERIES II.

Rotatory power (Scale Reading), 200mm. Turpentine.	Lbs. Oxygen absorbed by Turpentine.	Grms. H_2O_2 obtained.	Grms. H_2O_2 obtained per lb. Oxygen absorbed by Turpentine.
31	4.93	46	9
32	4.76	128	27
35½	11.20	675	60
36	11.20	1131	100

SERIES III.

Rotatory power (Scale Reading), 200mm. Turpentine.	Lbs. Oxygen absorbed by Turpentine.	Grms. H_2O_2 obtained.	Grms. H_2O_2 obtained per lb. Oxygen absorbed by Turpentine.
31	3.00	55	18
38½	6.66	617	92
39	7.00	542	77
39½	6.50	499	77
39½	7.35	573	77

SERIES IV.

Rotatory power (Scale Reading), 200mm. Turpentine.	Lbs. of Oxygen absorbed by Turpentine.	Grms. H_2O_2 obtained.	Grms. H_2O_2 obtained per lb. Oxygen absorbed.
30	6.80	278	41
30½	3.36	166	49
32	3.74	129	34
32	6.40	332	52
32	2.88	45	15
34	4.05	219	51
36	3.60	462	128
37½	6.00	389	65
38	4.80	479	99
38	4.76	336	70
39	3.60	293	81
41	8.05	540	67

SERIES V.

Rotatory power (Scale Reading), 200mm. Turpentine.	Lbs. of Oxygen absorbed by Turpentine.	Grms. H_2O_2 obtained.	Grms. H_2O_2 obtained per lb. Oxygen absorbed.
30	4.20	324	77
30½	3.00	263	88
31	1.30	117	90
31	3.00	130	43
31	10.85	701	64
31½	9.10	631	69
33	5.40	398	74
33	1.95	253	51
33½	5.75	624	108
35	3.90	239	61
36	7.80	712	91
36½	3.60	250	69

SERIES VI.

Rotatory Power (Scale Reading), 200mm. Turpentine.	Sp. Gr. of Turpentine.	Total Solid Residue left by 100cc. Turpentine, dry at 100° C.	Lbs. of Oxygen absorbed by Turpentine.	Grms. of H_2O_2 obtained.	Grms. H_2O_2 per lb. Oxygen absorbed by Turpentine.
30	.8642	1.166	4.42	681	154
31	.8620	1.432	.78	119	191
32½	.8732	1.330	3.84	290	75
32½	.8671	1.286	.92	229	246
33	.8703	1.750	—	161	—
35	.8649	1.338	2.52	3.0	126
36	.8661	1.080	.93	136	145
37	.8696	2.370	4.46	213	47
37½	.8706	1.300	3.74	399	106
37½	.8721	1.372	—	116	—
37½	.8670	1.350	—	267	—
38	.8697	0.942	5.48	615	112
38½	.8697	1.610	3.86	235	61
38½	.8658	.738	4.80	814	170
38½	.8633	.794	1.03	375	362
38½	.8706	.920	3.60	707	195
39	.8672	.802	4.44	503	113
39	.8632	.496	1.90	272	142
39½	.8656	.778	2.44	272	111
39½	.8677	1.298	3.44	525	152
40	.8698	1.400	7.24	791	109
40	.8697	1.236	5.27	984	186
40½	.8669	1.190	5.61	534	95
41	.8653	1.308	1.31	358	272
41½	.8650	.990	5.40	1669	198

In Series I. to V. the specific gravity of the turpentine was not determined, but was calculated at .865; in Series VI., however, it was determined by weight in the usual manner, but that of the oxidised oil was still done by the hydrometer.

SERIES VII.

Rotatory power (Scale Reading), 200mm. Turpentine.	Sp. Gr. of Turpentine.	Lbs. of Oxygen absorbed by the Turpentine.	Grms. of H_2O_2 obtained.	Grms. H_2O_2 per lb. of Oxygen absorbed by Turpentine.
34½	.8646	—	66	—
34½	.8662	—	612	—
35½	.8683	2.010	274	136
35½	.8666	—	562	—
39	.8611	1.829	311	170
39	.8685	.465	166	357
39	.8636	3.151	591	187
39	.8612	.232	31	133
40	.8611	2.224	427	183
41	.8666	1.620	483	298
41½	.8651	—	531	—
41½	.8612	4.450	954	214
41	.8660	0.588	356	605

In this series the specific gravities of the oxidised oils, as also those of the turpentine employed, were determined by weight. It is seen from these results that Russian turpentine as met with in commerce ranges in specific gravity from '8620 to '8722, and that it contains from '496 to '237 per cent. of matter by weight in volume which is non-volatile at 100° C.

It is almost impossible to draw any conclusions regarding the production of peroxide of hydrogen in relation to the rotatory powers of the turpentine examined; but, if it be safe to conclude anything at all, it is that the oils of the higher rotatory values serve best, and that next in order come those of low rotatory value. If this conclusion be drawn, then we must look, not alone to sylvestrene (+34° per 200mm.: Atterberg, confirmed by Tilden) as the source from which the peroxide of hydrogen is obtained, but also to a hydrocarbon of comparatively high rotatory power not identical with the chief constituent of American turpentine (australene), for that substance is not readily oxidisable and is not a prolific source of peroxide of hydrogen.

I, however, hesitate to draw any fixed conclusion until a further series of observations have been made upon different samples of Russian turpentine to be submitted to oxidation in the same oxidiser under precisely identical conditions. In the meantime the results of my observations herein recorded have some interest of their own.

In conclusion, I may remark that I cannot confirm the statements which have been placed on record regarding the marked physiological effects, including violent headache, induced by Russian turpentine. Such effects have not been observed in the works of the Sanitas Company, Limited, where the air is always loaded with the vapour of Russian turpentine. On the other hand, the atmosphere is balmy and pleasant, and quite devoid of noxious properties.

DISCUSSION.

The CHAIRMAN said one of the questions which had yet to be solved was the chemical history of turpentine. The suggestion now made as to the possibility of different products coming from different parts of the tree was what might be expected from the exceedingly diversified manner in which the active principles of plants were distributed, and, where more than one active principle was found in the same plant, the very varied way in which they were severally distributed. For example, in a different branch of physiological chemistry, it was found in the distribution of the various cinchona bases in trees that one part of the tree would produce chiefly laevo-gyrate alkaloids, whilst the root of the same tree would produce chiefly dextro-gyrate alkaloids. There was nothing at all surprising, therefore, that one part of the same *pinus* should produce one form of oil of turpentine, whilst another part of the same tree would produce a totally different one. The question here opened up of the relation between the optical and the chemical properties of various turpentines to their oxidising power was a very interesting one, and probably these secondary actions of the turpentine might throw a considerable light on their constitution.

Mr. THOS. CHRISTY, agreeing with the chairman's remarks, thought that the products greatly depended on the nature of the sap, rising in the tree at the time. To obtain pistachios of fine flavour, trees had to be tapped to get rid of the turpentine, and prevent the flavour reaching the nuts. Possibly the character

of turpentine depended as much on the time of year as on the part of the tree from which it was extracted.

Mr. FENNER said as far as his experience with rosin spirit (to which substance Mr. Kingzett had verbally referred) went he had always found that either in the crude or rectified state it was a valuable article of commerce, quite irrespective of its being used as an adulterant. Brunswick Black, Black Japan, a black varnish, pine varnish, and many other useful articles were made with it. He remembered the time very well when he had sold highly rectified rosin spirit for as much as £80 a ton; at the present time if fairly rectified it was worth £15 to £16, as compared with turpentine at about £27. It was quite clear to his mind that no trading house would buy turpentine adulterated with rosin spirit, except to a very slight degree, because the odour of the two was so distinct that they could not well be mistaken. With reference to using it in paint, that could only be for rough work covering a very large surface, or making all descriptions of ship-bottom compositions. Russian turpentine was an article which had been known in commerce for many years, and was very useful in its way. Lately he had seen in the London market a beautiful article introduced from Poland, almost water-white, having a strong and distinct odour. In that case also he knew it could not be mixed or disguised in the shape of turpentine, and as far as his knowledge went of these various fluids they were highly useful, and had a fair commercial value.

Mr. KINGZETT, in reply, said he believed that less than ten years ago, Russian turpentine was comparatively a drug in the market, and was only employed by paint and varnish makers when American turpentine went up to a very high price. Since then his company had used large quantities, and had become, indeed, probably the largest consumers in the world of Russian turpentine, and consequently there had been an increasing interest in the article, so that now it competed to some extent with American turpentine in the English market for use in paint and varnish-making. So long as it was used fairly as a solvent which could be afterwards got rid of by volatilisation, he saw no objection to its use or even that of rosin spirit, for they served just as well as a high-priced turpentine. At the same time, he protested very strongly both as a chemist and as a business man against mixing rosin spirit with turpentine, and particularly to its being sold as turpentine. Whilst allowing that English-made rosin spirit had such a characteristic odour that even when present in a very small percentage admixed with turpentine it could be detected by the smell alone, the fact remained that rosin spirit as made on the Continent (in Germany) was quite a different product. It was very highly refined, and the highest qualities of this kind could not be bought at the present time under £19 to £20 per ton. It was possible to mix a large proportion of this substance with good Russian turpentine without detection, even by persons most familiar with the article, otherwise than by chemical means. The two samples of rosin spirit he had shown that evening were of this character, and when mixed with Russian turpentine the adulteration could not be detected except by analysis. Only recently he had a large parcel of so-called Russian turpentine offered him, which upon examination he found to be absolutely innocent of turpentine; it did not contain 1 per cent., being entirely German-made rosin spirit devoid of rotatory power. It was this reprehensible practice of adulteration which enabled merchants to offer Russian turpentine at any figure which would be likely to secure trade.

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BUSINESS FOR NEXT MEETING.

February 1.—Mr. T. N. Whitelaw—"Notes on the Nature of Soaps."

February 2.—Mr. Charles Fawsitt—"On the Waste Carbon Dioxide from the Manufacture of Alcohol."

Notices of papers and communications for the meetings to be sent to the Local Secretary.

The Third Meeting of the Session was held in the Rooms, 207, Bath Street, on Tuesday, 5th January, 1886.

PROF. MILLS IN THE CHAIR.

THE SPECIFIC HEATS OF GASES AT HIGH TEMPERATURES.

BY DUGALD CLERK.

THE experimental determination of the specific heat of any gas at ordinary temperatures between 0° and 200° C. is a matter of very considerable difficulty. At elevated temperatures, 1000° C. and upwards, the difficulties so greatly increase that the method available for lower temperatures becomes quite impracticable. Until very recently no urgent commercial need pressed for exact knowledge on this subject. The steam and hot air engines hitherto brought into use dealt with their working fluids at comparatively low temperatures; accordingly chemists and physicists have not applied themselves to the exact determination of the necessary constants at the higher temperatures. Pure science, of which so much is now heard, seldom supplies motive sufficiently powerful to induce the necessary expenditure of means and labour always requisite for exact quantitative work. The requirements of industry, chemical and otherwise, have really given rise to most of the exact science of to-day, instead of, as is often represented, science originating industry. Under the stimulus afforded by the growth of the steam engine, physical constants for steam, for air and other gases and liquids, have been exactly determined; indeed, the whole science of thermodynamics seems to have originated in its study. Quantitative electricity, as an exact science, is largely indebted for its present position to the industrial requirements of the telegraph and the electric light.

In the same way quantitative chemistry has benefited from chemical industry.

The recent development, the gas engine, now urgently calls for accurate quantitative knowledge of many properties of gaseous explosion, both chemical and physical. At present but little is accurately known; the object of this paper is to point out what that little is.

Regnault experimented upon many gases by passing a given volume at a known temperature through a spiral tube surrounded with water contained in a vessel which formed the calorimeter, the temperature of entry and exit of the gas being observed together with the change in temperature of the calorimeter thermometer: the amount of heat added to or abstracted from the calorimeter is known, and therefore the capacity for heat of the gas. The results obtained are evidently the specific heats at constant pressure; the heat applied not only raises the temperature but it also causes expansion against a resistance, the atmospheric pressure. When the volume of the gas is kept constant by confining it in a closed vessel, less heat is required to raise it through a given temperature. Less heat by just the amount of work which would be done against atmosphere if expansion were permitted.

The specific heats are known as specific heat at constant pressure, and specific heat at constant volume, or sometimes as the apparent and true specific heats. Some physicists consider the specific heat of any substance at constant volume when in the truly gaseous state as the true specific heat of the substance in all states, and the difference between this and the values actually found for solids and liquids heated under ordinary conditions they consider to be due to the internal work done by the heat in expanding the solid or liquid against the cohesion proper to the substance.

The following are the specific heats of the gases concerned in a gaseous explosion for low temperatures as given by Regnault:—

SPECIFIC HEATS OF GASES (REGNAULT).

(Gases. Unit weights Water, 1. Unit volumes Air, 1.)

	Constant pressure.	Constant volume.	Constant volume.
Air	0.237	0.168	1.00
Oxygen	0.217	0.155	1.02
Nitrogen	0.214	0.173	1.00
Hydrogen	3.409	2.406	0.99
Carbonic Acid	0.216	0.171	1.55
Carbonic Oxide....	0.215	0.173	1.00
Water (Steam)	0.480	0.369	1.36

The specific heat of solid and liquid bodies is found generally to increase with increasing temperature, the increase being more rapid as the melting point is approached in a solid or the boiling point in a liquid. In gases very little change is observed, a slight change—an increase—occurring when it is easily liquefied—that is, when it is not greatly removed from its boiling point in the liquid state. The change is so slight that it has hitherto been assumed by many physicists that a perfect gas will not change appreciably its capacity for heat even at very elevated temperatures. The remarkable law of Dulong and Petit, that the specific heats of the elements, in similar states, when multiplied by their combining weights give a constant number, holds with but few exceptions. It is true with close approximation for the elementary nearly perfect gases, also for compounds which are nearly perfectly gaseous.

The molecular heat of an elementary gas is its specific heat at constant volume into twice the atomic weight; the molecular heat of a compound gas is its specific heat at constant volume multiplied by its molecular weight.

MOLECULAR HEATS OF GASES (CONSTANT VOLUME).

(Limits 0° to 200° C.)

	Specific heat at constant volume × molecular weight.	
Oxygen	0.155 × (16 × 2) =	4.96
Nitrogen	0.173 × (14 × 2) =	4.84
Hydrogen	2.106 × (1 × 2) =	4.21
Carbonic Acid	0.173 × (28) =	4.84
Carbonic Oxide	0.171 × 44 =	7.52
Water (Steam)	0.369 × 18 =	6.64

The members will kindly pardon these quotations of matters familiar to all of them; they are necessary for reference in what follows. In France, Messrs. Mallard and Le Chatelier,* and, later, Messrs. Berthelot† and Vieulle, consider that they have solved the problem of determining the specific heats of gases at temperatures approaching 4000° C.

Chatelier. If true they are, indeed extraordinary results.

But are they true? Do the experiments warrant the conclusions? In the author's opinion those scientists have been completely misled by the nature of their experiments; to him there does not seem the smallest reason for supposing any such change in the properties of gases.

The experiments consist entirely of measurements of the pressures produced by the explosion in a closed vessel of various mixtures of oxygen and combustible gases, H, CO, and many others, together with a diluting gas such as nitrogen, carbonic acid, or steam. The exact proportions of the gases were carefully measured, and therefore the total heat capable of being evolved on complete combustion was also known. Explosion was accomplished by

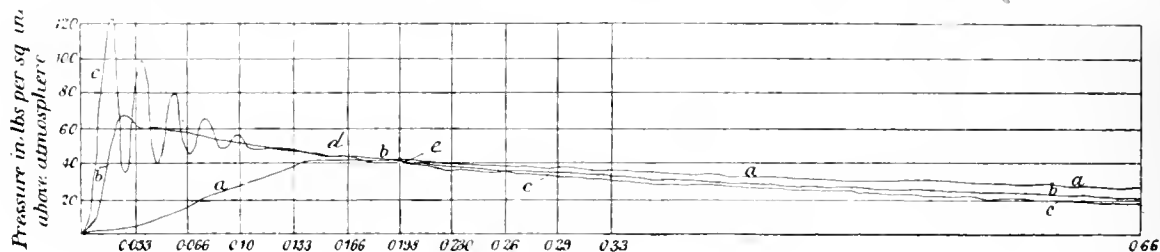


FIG. 1.

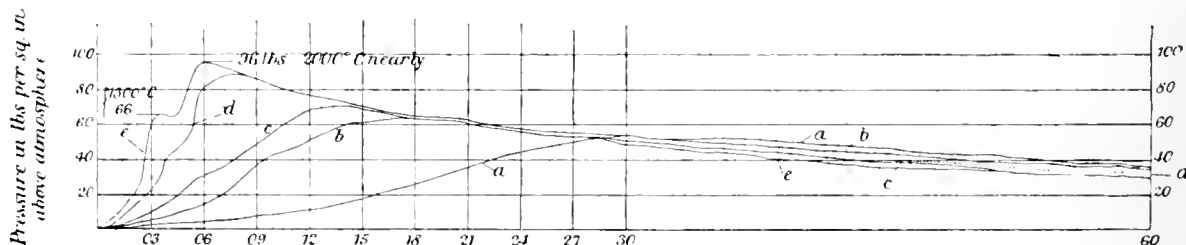


FIG. 2.

by a long and skilful set of experiments upon gaseous explosions. They are now agreed that contrary to general supposition, the specific heats of gases change very greatly with increasing temperature; at high temperatures, however, as at low, oxygen, nitrogen, hydrogen, and carbonic oxide still obey Dulong and Petit's law; their molecular heats are, within the limits of experimental error, still equal to one another.

Taking 4.8 as their mean molecular heats between 0° and 200° C., these chemists state that between 0° and 4500° C. the mean value becomes 9.8—that is, in passing from 0° to 4500° the capacity for heat so greatly increases that the average value is doubled. The molecular heat of chlorine at constant volume between 0° and 200° C. is 6.6; between 0° and 1800° C. it is 15.3. It is more than doubled.

Hydrogen 0° to 200° C. is 4.8 and 0° to 1800° C. it is 5.1.

Similarly steam, which is 6.6 between 130° and 230° C. is between 0° and 2000° C. 13.2, and between 0° and 4000° C. 19.9. Between 0° and 200° C. CO₂ is 7.52, and between 0° and 2000° C. it is about 18.0. All of those are Berthelot and Vieulle's figures. They are nearly in accord with those of Mallard and Le

the electric spark, and an indicator such as is used for testing steam engines made a tracing, which gave the maximum pressure produced by the explosion. From this maximum pressure may be calculated with considerable accuracy the corresponding temperature, assuming Charles' law of the expansion of gases by heat to hold for high temperatures as well as low. When this is done it is found that the temperature is not nearly so high as would have been anticipated, assuming complete evolution of heat and constant specific heat. This beautiful method of studying explosions was originated by Bunsen†, and he called attention to the fact of a great deficit of pressure, but explained it by assuming that at maximum pressure combustion is incomplete, dissociation setting a limit to temperature by the failure of chemical combination at the high temperature of the explosion. The French chemists differ from Bunsen, and consider that the influence of dissociation is trifling, the real explanation of the apparent suppression of heat being increase in the capacity for heat.

The author has made many experiments to determine the nature of gaseous explosions; the apparatus used consists of a strong cast-iron cylinder, of seven inches diameter and eight inches long internal measurement, accurately bored and the end covers

* Mallard and Le Chatelier, Bull. Soc. Chem. (2) 39; Chem. Soc. Journal (Abstract), 1883, p. 844.

† Berthelot and Vieulle, Annales de Chimie et de Physique, 1885, pp. 13–90.

‡ "On the Temperature of the Flames of Carbonic Oxide and Hydrogen," by R. Bunsen. Phil. Mag., 1867, vol. xxxiv. p. 489.

turned, so that the capacity was accurately known by measurement. Upon the upper cover is placed a Richards' indicator, in which the reciprocating drum is replaced by a revolving one; the rate of revolution is adjusted by a small fan, a weight through suitable gear giving the power. The cast-iron cylinder is filled with the explosive mixture to be tested, the drum is set in movement, the pencil of the indicator pressed gently against it, and the electric spark is passed between two points in the mixture. The revolving drum is enamelled, and the pencil is a black lead one. The pressure produced by the explosion acts upon the indicator piston, and a line is traced upon the drum which shows the rise and fall of pressure, the rising line traces the progress of the explosion, the falling line the progress of the loss of pressure by cooling. The curve obtained not only registers the highest pressure of the explosion, but it indicates the time taken to attain that pressure, and the time taken to lose it by cooling.

The curve supplies complete information of the whole course of the explosion, the maximum pressure, the time of explosion, and the time of cooling. Fig. 1 shows facsimiles of curves obtained from the explosion of hydrogen and air mixtures.

The following table gives the results calculated from these diagrams:—

EXPLOSION IN A CLOSED VESSEL.

(CLERK'S EXPERIMENTS.)

Mixtures of Hydrogen and Air. Temp. before Explosion 16° C., Pressure 14.7 lb. (Atmospheric).

Mixture		Max. press. above atm. in lbs. per sq. in.	Time of Explos.	Max. Temp. of Explos.	Calculated press. above atm. in lbs. per sq. in.
H.	Air.				
1 vol.	6 vols.	41	0.15 sec.	826 to 909° C.	88.3
1 vol.	4 vols.	68	0.026 sec.	1358 to 1539° C.	124.0
2 vols.	5 vols.	80	0.01 sec.	1615 to 1929° C.	176.0

The table clearly shows that temperature has been checked in some manner, the temperatures, and therefore the pressures, are but little more than half what they should be if all the heat is evolved by the moment of maximum temperature while the specific heat of the gases remains constant. The French chemists assume that all the heat is evolved, and the curves *B* and *C* do not contradict this assumption; but what is to be made of the curve *A*? The explosion is slower, the increasing line taking 0.15 sec. to attain maximum. When maximum is attained, the pressure does not begin to fall away at once, but remains stationary for nearly 0.07 sec. That is the mass of hot gas at a temperature of about 900° C., although in contact with cold cast-iron walls at a temperature of 16° C. appears to be losing no heat, the heat is necessarily flowing from it by the intense convection currents, therefore heat is being supplied at just the rate at which it is being withdrawn. The only source of heat here is combustion. In this instance combustion cannot be complete at the point of maximum pressure; any calculation of specific heat from the suppression of heat in this case would be plainly erroneous. When the pressure begins to fall in this case it falls very slowly, so slowly that it is impossible to say that combustion is complete even when fall commences, there is no reason to believe that it is. A further study of the three hydrogen curves will prove that even in *B* and *C* where fall commences immediately on the attainment of maximum pressure, there is every reason to believe that

combustion is still proceeding on the falling line. The falling curves *B* and *C* intersect at the point *D*, and the curve *C* falls below *B*. At the point of intersection *D*, in both experiments, the gases are at the same temperature, and if combustion was then completed, as required by the theory of Mallard, Le Chatelier, and Berthelot, then the gases from that point of similar temperature must cool at equal rate, the fact that *C* cools quicker than *B* shows that *B* must be receiving heat, or more heat than *C*, that is, combustion is still going on and adding heat. The curve *A* intersects *B* and *C* at about *E*, and it remains much above both; it is evident that combustion is keeping up temperature to a greater extent in *A* than in the other two. So much for hydrogen and air. Coal gas mixtures show the same phenomena, and something more. Fig. 2 shows facsimiles of curves obtained from Glasgow coal, gas, and air mixtures in the same manner, and in the same explosion vessel. The following table gives the results calculated from the diagrams:—

EXPLOSION IN A CLOSED VESSEL.

(CLERK'S EXPERIMENTS.)

(Mixtures of Glasgow Coal Gas and Air. Temp. before Explosion 18° C., pressure atmospheric.)

Mixture		Max. Press. above Atmos. in lbs. per sq. in.	Time of Explosion.	Max. Temp. of Explosion.
Gas.	Air.			
1 vol.	13 vols.	52	0.28 sec.	1017° C.
1 vol.	11 vols.	63	0.18 "	1265° C.
1 vol.	9 vols.	69	0.13 "	1384° C.
1 vol.	7 vols.	89	0.07 "	1780° C.
1 vol.	5 vols.	96	0.05 "	1918° C.

The curves *A*, *B*, *C*, *D*, *E*, Fig. 2, show in the most emphatic manner that combustion continues long after complete explosion, in *A*, *B*, and *C*, the maximum temperatures of 1047° C., 1265° C., and 1384° are sustained for a considerable time, necessarily by addition of heat from continued combustion, and curves *D* and *E* fall so gradually from maximum pressure that it cannot be for a moment assumed that combustion is complete at maximum pressure. The explosion part of the curve *E* shows a striking peculiarity; the explosion which causes the pressure to increase at a continually accelerating rate till 66 lb. pressure has been attained, suddenly seems to lose power of further increase, and at that pressure, about 1300° C., an actual fall occurs, lasting about $\frac{1}{100}$ part of a second. After that, an increase again occurs, till a temperature of nearly 2000° C. is attained, but the increase is never so rapid as at first. At first, the author was inclined to attribute this to a trick of the indicator, but the hydrogen curves taken with the same instrument exhibited no such peculiarity all of the coal gas ones do, as may be seen in *D* and *C* distinctly, and less distinctly in *B*. It is quite evident that a flame originated at one point in a mass of explosive mixture will spread with continual acceleration in a confined space, the compression of the un-inflamed portion by the inflamed portion causing a rapid rate of propagation of flame. No pause in increase of temperature can therefore be supposed to occur in a mixture while the flame continues to spread. The flame must be all through the mass before the pause at 1300° C. What then causes the increase after the pause? To the author it seems that the flame spreading through the mass burns the free hydrogen first, and then at the high temperature

1300° C., the hydrocarbons decompose and the remaining carbon and hydrogen combine with the oxygen more slowly at first causing increase of temperature, and then gradually overpowered by the cooling of the walls; on the downward curve heat is still being evolved but at too slow a rate to prevent fall. In these experiments the rate of rise of pressure is not great. Fig. 3 is the curve taken from a compressed mixture of gas and air in the same vessel, the time of explosion is 0.03 sec., and the maximum temperature remains constant for 0.1 second. Combustion must be continued at least during that $\frac{1}{10}$ sec., and there is no reason whatever for believing that it does not continue at a slower rate during fall.

These experiments, in the author's opinion, completely prove that whatever explanation is given, combustion, or burning, is not complete at maximum pressure; that is easily evident in many of the curves, and not one curve contradicts the induction. This being so, it is obviously impossible to say that the specific heat of these gases changes in the smallest degree by high temperature, so long as there is the faintest doubt of complete combustion at maximum

of flame varies from 2 feet in $\frac{1}{10}$ gas mixture to 14 feet per sec. in $\frac{1}{10}$ gas mixture, both Glasgow gas.

The author differs entirely, therefore, from Messrs. Mallard and Le Chatelier, and Messrs. Berthelot and Vielle, and considers that the experiments of those gentlemen do not prove any increase whatever in the specific heats of gases at high temperatures, and he asks the members of this Society to reject their results until it be proved by them that combustion is complete at maximum temperature of the explosions tested by them.

DISCUSSION.

Mr. ROWAN: There are very few persons who can discuss the subject of Mr. Clerk's paper in detail, as it is well known that the author is one of the pioneers in that field of research. I have followed his paper, as I did his previous one on "The Theory of the Gas Engine," in which this line of inquiry was foreshadowed, with very great interest, and think that his conclusions seem well founded. Nevertheless, I am not competent to pronounce a decided opinion on the subject. I should be glad if he could give a

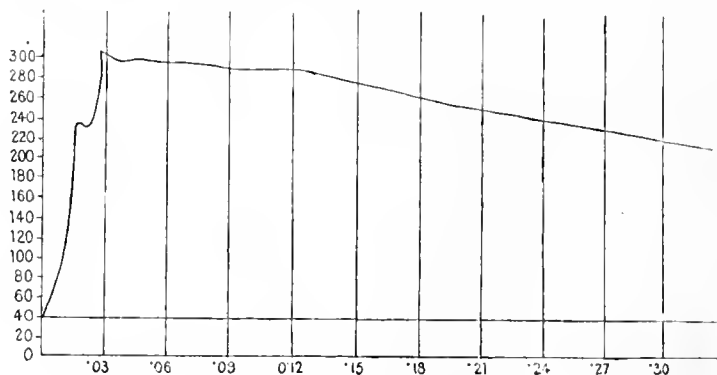


FIG. 3.

pressure, Messrs. Mallard and Le Chatelier's experiments and Berthelot's values for the specific heats of gases at high temperatures are necessarily incorrect.

The error seems to have arisen in supposing combustion necessarily complete when the whole space is filled completely with flame, confusing complete inflaming of the mass with complete burning of it. In the case of solid fuel filling an ordinary grate, the whole mass may be vividly incandescent but yet not all consumed. In a coal or flour dust explosion every particle of the minute solid combustible may be incandescent, but some time will elapse, very minute certainly, but still measurable, before it will be completely consumed. The most rapid rise of pressure in such an explosion will occur necessarily when the flame is spreading, but the little particles may glow more fiercely after that and cause further rise, which rise will continue till the steady rate of cooling overpowers the rate of combustion. To get any certain value for the specific heat of a gas at a high temperature, a method of heating without combustion must be discovered.

These experiments give interesting information on many points, and show plainly the error of using the old method of calculating the *calorific intensity of a fuel*: the highest temperature obtained by burning hydrogen at constant volume does not exceed 1800° C., it should be 4100° C. The highest temperature of the explosion of Glasgow coal gas and air is 2000°, and the highest pressure, starting at atmospheric pressure, is 96lb. above it. The rate of propagation

reason for the fact that the actual maximum temperatures obtained in his experiments fall so far short, as he has stated, of the theoretical temperatures due to the explosions. If Mr. Clerk has made any analysis of the gases during different portions of the time represented in his diagrams, this would throw light on the question whether the combustion was incomplete, as he holds, at the point of maximum temperature and pressure. With regard to the flat portion of the indicator diagram, perhaps this might in part be due to the fact that the gases are under considerable pressure, and in expanding may give out some portion of the heat represented by the curve.

Mr. BELBY: The difficulty attending the measurement of instantaneous changes of pressure, which at first sight seems to militate against the accuracy of all such determinations, seems to have occupied the attention of MM. Vielle, Mallard, and Le Chatelier (*Compt. Rend.* 95, 1280 and 1352). Mr. Clerk, also, has evidently had this difficulty before him, and he will no doubt be able to show that his form of pressure indicator is fully competent for the work attempted. Notwithstanding a necessary reserve in accepting any of these measurements as actually indicating the *maximum pressures* of explosion, the evidence brought forward by Mr. Clerk leaves hardly a doubt that the failure of certain exploded mixtures of gases to reach the calculated pressure is to a great extent due to retarded combustion. In studying this retarded combustion, it would evidently be important to distinguish, and *separately* to determine the influence of (a) temperature, (b) pressure, (c) excess of

one or other of the active gases, and (*d*) ratio of surface to capacity of the exploding vessel. *a* and *b*. The influence of temperature and pressure should evidently be studied separately, as the dissociation temperature will most likely be raised by increased pressure. It seems a necessary preliminary to determine the dissociation temperature of gaseous water at low pressures, due account being taken of the nature and extent of the surface of the apparatus in which the dissociation is effected. *c*. Berthelot and Vielle have so far studied the influence of dilution of explosive mixtures with excess of either constituent or with a neutral diluent, but judging from the abstract of their paper in the *Chem. Soc. Journ.* (abstracts 1884, 804), the results are not conclusive. *d*. Recent researches on the influence of the metal of steam engine cylinders on the indicator diagram show such remarkably rapid transference of heat from steam to metal, and *vice versa*, even in comparatively large cylinders in which the ratio of surface to volume is small, that it seems not improbable that this ratio may influence the maximum temperature of gas explosions. Berthelot and Vielle evidently attach some importance to this ratio.

Professor MILLS: We are much indebted to Mr. Clerk for having brought before us the results of an extended range of experiments on this important subject. The propagation of chemical change has been but little investigated; and scarcely anything of an advanced character has been distinctly educed—viz., a single point in the theory of close fuses. Mr. Clerk's experiments and drawings show us very clearly that explosive combustion, even under very considerable pressure, is not a sudden but a gradual act, the maximum effect being attained much more rapidly than it is lost. This slow fading away of the effect is doubtless due to several co-operating causes, of which dissociation, due to the intense heat, is very possibly the chief. Pressure, on the other hand, would tend to accelerate the ignition; and ignition would presumably spread much more quickly in media of inferior viscosity. In endeavouring to explain complex phenomena of this kind, some assumptions have naturally to be made; but Mr. Clerk seems to have made out a strong case against the assumption that there is any increase in the specific heat of gases at a high temperature.

Mr. CLERK: It is difficult to give an explanation of the fact that the observed temperatures of actual explosions are so much lower than those to be expected on theoretical grounds, for the phenomenon is a complex one. In some cases—e.g., exceedingly explosive mixtures, dissociation must be the main cause, but this can hardly be so in other cases, as when very dilute mixtures are exploded. The experiments of the French chemists were made at intermediate temperatures, the only means they employed of altering the temperature of the explosion being to dilute their mixtures of gases. I cannot see that compression of the gases can effect the curve on the diagram, owing to the considerable velocity with which flame travels. I have made no analyses of the products of combustion at different periods of the explosion; it would be an exceedingly difficult matter to do so. The number and variety of the experiments made by Berthelot and the others are no proof of the truth of their results, for in all the assumption is made that the combustion at maximum pressure is complete, while my experiments go to show that this is not the case. These experimenters do not seem to have studied the crossing of curves as I have done. Further, in many experiments they used an inaccurate indicator—the Bourdon gauge with a pencil attached. I cannot believe that compression retards combustion. Sir Humphry Davy in his experiments

on the safety lamp, found the opposite to be the case. Thus, for example, he found that a mixture of hydrogen and oxygen in the proper maximum explosive proportions could not be exploded if the pressure was reduced to 1-18th of atmospheric pressure. Again, a mixture of 1 part of Manchester gas with 14 parts of air exploded with difficulty, while a mixture of 1 part of gas and 14½ parts of air does not explode at all, unless subjected to a slight increase of pressure. In a compressed gas the conversion currents have not the same freedom of motion as in an uncompressed gas, therefore in an explosion of the former there will be far less flow of heat through the sides of the vessel. The proportional surface for cooling is reduced, hence the flattening of the curve in explosions of previously compressed gases. It is impossible to increase the maximum pressure by diminishing ratio of cooling surface for similar mixtures of gases, except to a very slight extent. Berthelot and the others have not worked with compressed gases at all; my experiments on compressed mixtures are, I believe, the only ones yet published. It is not necessary to assume specific heats in order to calculate the temperature of the explosion: it is only necessary to assume that Charles' law holds good for high temperatures. The explosion vessel itself is used as a thermometer. Berthelot and Chatelier have no more right to say that the specific heats have altered than that Charles' law has failed. Experimental work is much required on this subject, as pointed out by Mr. Rowan, Mr. Beilby, and Prof. Mills. It is extraordinary that so little accurate knowledge is in existence on the subject of dissociation of water and carbonic acid.

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February 12.—P. A. Maignen, Esq., "On the Purification of Water."

March 12.—F. H. Bowman, Esq., D.Sc., "On the Structure of Fibres used in Textile Fabrics."

For the following papers dates are uncertain:—

H. Forth, Esq., "On Some Facts relating to the Use of Poisonous Materials for Dyeing Hosiery."

L. Archbutt, Esq., "On Some Points in the Analysis of Oils, with special reference to Olive and Rape Oils."

Notices of papers and communications for the meetings to be sent to the Local Secretary.

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ERRATA.—On page 730 of vol. iv. of this Journal, right column, line 4, "Morgan" should read "Morgans." The 5th line, "University College, Bristol," should follow the 1st line, "Meeting held November 12th." In line 7, "page 19" should read "page 319." Page 732, left column, lines 15 and 16, "100' under proof. If then the fire," etc., should read "100' under proof, if then the fire." Page 733, left column, line 3, for "discolouring" read "decolourising"; right column, line 40, "anarrisabout" should be "anarris about." Page 734, left column, line 13 from bottom, "condensed water to" should be "condensed water added to"; right column, line 18 from bottom, "a rank of" should read "a rank 16ft. 8in. long of." Page 735, left column, line 27 from bottom, "contains (proof spirit)" should read "contains (taking proof spirit)."

Meeting held December 12.

ON THE COMPOSITION AND METHODS OF MANUFACTURING COMMERCIAL SULPHATE OF ALUMINA.

BY J. BEVERIDGE,

Of Ely Paper Mills, Cardiff.

THE varieties of sulphate of alumina found in the British market are salts of variable composition, and are met with under different names and in various degrees of purity. For many years past the more impure varieties have been known, and have had an extensive application in several of the great industries of this country, successfully accomplishing the object for which they were intended—i.e., displacing the more expensive salts, ammonia and potash alum. Quite recently, the manufacture of the pure salt has made a rapid advance, owing to the discovery of new methods of manufacture, and this advance is still likely to continue, principally because the product contains a high percentage of alumina, can be had perfectly free from iron, and in other respects commercially pure, and at such a price as to prove a much cheaper source of alumina than either of the alums.

The commercial salts produced by different makers differ somewhat in the percentage of Al_2O_3 they contain, and in this respect do not resemble the alums whose composition are well defined and practically constant. The want of uniformity in the different makes is said to have been advanced as an objection to the use of the salt by those consumers whose operations are so delicate that a slight alteration in the amount of alumina used will not produce the desired effect, and whose management is not so perfect as to calculate the exact amount required. Whether this be so or not I am unable to state, but it seems reasonable when we recollect the various delicate shades produced by the dyer and calico-printer. This difference in percentage of Al_2O_3 is merely noticeable when the products produced by different makers are compared, and does not generally exist when we consider each individual make. One of the best makers of sulphate of alumina in this country produces it containing no iron, and in other respects commercially pure, and having a practically constant composition of 16 per cent. Al_2O_3 .

The principal impurity, as is well known, in sulphate of alumina is iron, and in many industries the presence of this element renders the salt perfectly worthless. In the best qualities this impurity is absent, or nearly so, whilst in the lower qualities it ranges from a few hundredths to about three-fourths of a per cent. Consumers tend almost wholly to obtain the article as free from iron as possible.

As the ores of alumina do not exist in nature pure enough to be industrially converted directly into a sulphate which could compete with the alums, but are always more or less associated with iron, the main operation in this manufacture is the separation of

this body; and I propose placing before you a few details respecting the chemical principles upon which are founded the methods that have been proposed and adopted to accomplish this object, as well as to treat of the manufacture and composition of the cruder varieties.

The names under which the most important forms of sulphate of alumina are met with in this country are these:—

- (1) Aluminous cake.
- (2) Aluminous-ferric cake.
- (3) Sulphate of alumina, or concentrated alum.

Each of these varieties differs from the others in possessing some distinguishing feature—e.g., aluminous cake contains a large proportion of insoluble matter, which is absent in the other two, whilst aluminous-ferric cake, as the name implies, contains a large percentage of iron. Under the name sulphate of alumina, or concentrated alum, is included the salt having a low percentage of iron, or none at all, and in other respects commercially pure.

The raw material employed in this country as a source of alumina when manufacturing these compounds is either China or other clay, containing a small proportion of iron, or the mineral known as "bauxite." China clay is not now very largely used for the preparation of the pure salt, because it is much more difficultly soluble in sulphuric acid than either "alum clay" or "bauxite;" but it is the source of alumina in the manufacture of aluminous cake. The "alum clay" mined by the Eglinton Chemical Company is a valuable material, inasmuch as it contains little iron and, comparatively speaking, little silica on the alumina present; but as the alumina is partly combined with silica, it would appear to be somewhat more difficult to dissolve than "bauxite," whose alumina exists chiefly as hydrate. In practice the difference in solubility between these two minerals is not much, if any at all.

The analyses given on p. 17 show the composition of the various qualities of these raw materials.

I have calculated the amount of ferric oxide in each of these analyses on 15 parts of Al_2O_3 in order to show the relative amounts of iron to be got rid of when manufacturing the pure salt, as also the better to compare the aluminous materials themselves.

Comparing these analyses, it will be observed that the Cornish clay contains the least amount of iron on 15 parts Al_2O_3 , only the highest or "Gertrude" quality of bauxite approaching it in this respect. Usually, however, a less pure clay is employed containing from 0.4 to 0.75 per cent. ferrous oxide. I have found the proportion of silica to alumina in China clays to be fairly constant. In medium qualities the ferrous oxide seldom exceeds 0.45 per cent.

The other aluminous materials—viz., Irish hill "bauxite" and Eglinton "alum clay,"—both of which are found in extensive deposits in Ireland, and whose alumina exists largely as hydrate, are more easily soluble in sulphuric acid than China clay, and can be obtained nearly as free from iron. I say nearly, because there are China clays in the market containing less iron per unit of alumina than the purest variety of commercial "bauxite" or "alum clay." The insoluble matter from these Irish minerals, amounting to at least 25 per cent. of their original weight, is of a dark brown colour and has not the same commercial value as that from the Cornish clay, which is perfectly white when dried, and contains often more than 80 per cent. silica and may be used for a variety of purposes. Bearing these considerations in mind, and also comparing the relative costs of these aluminous materials, it would appear that China clay is as

cheap a source of alumina as either "bauxite" or "alum clay," notwithstanding it is more difficult to dissolve and requires to be well calcined and finely ground before being used.

These aluminous materials available for use in the manufacture of these salts contain too great a proportion of iron to enable the manufacturer to produce directly an article pure enough to satisfy many consumers; and, as the iron is as soluble in sulphuric acid as the alumina, it is necessary to remove this metal wholly or in part before the sulphate of alumina or concentrated alum of commerce can be obtained. Various attempts have been made to free the raw aluminous material of iron previous to acting upon it with sulphuric acid. Kynaston, Newlands, Condy and others have worked in this direction,

a sulphate of alumina containing not more than from 0.1 to 0.2 part metallic iron on 16 parts Al_2O_3 . As the separation of the iron in this and in analogous methods is at best only partial, and presents technical difficulties, such processes are of little value. All attempts based on the principle involved in the foregoing have therefore been abandoned in favour of the much more complete and practical methods recently invented to remove the iron from the sulphate of alumina liquors by mechanical or chemical means.

The aluminous materials above mentioned are not in a fit state, as they occur naturally, to be used directly in this manufacture. Irish Hill "bauxite" and Eglinton "alum clay" are both dried in order to expel the hygroscopic water, and are then finely ground. They may be obtained in this state or in lumps. China clay, on the other hand, requires to be

ANALYST.....	"Bauxite" (Irish Hill Bauxite Co.)				"Alum Clay" (Eglinton Chemical Co.)			China Clay.
	"Gertrude" Quality.	No. 1 Quality.	No. 2 Quality.	No. 3 Quality.	No. 1 Quality.	No. 2 Quality.		
	PATTINSON.	PATTINSON.	PATTINSON.	PATTINSON.	PATTINSON.	PATTINSON.	FRESENIUS.	UNKNOWN.
	%	%	%	%	%	%	%	
Al_2O_3	59.37	53.83	52.00	46.13	52.37	42.42	48.83	39.74
Fe_2O_3 .....	.53	1.57	1.57	15.14	1.29	1.54	2.24	FeO .27
CaO .....	.21	.62	.79	.18	.48	.46	.62	.36
MgO .....	.11	.13	.20	.26	trace	trace	.17	.11
K_2O and Na_2O} .....	.09	.01	.08	.28	.06	.04	.14	—
SiO_2	11.43	8.67	12.00	10.40	13.15	27.50	15.88	16.32
Titanic Acid	6.35	5.80	6.20	4.20	5.20	9.10	5.02	—
Sulphuric Acid .....	.04	.07	.07	.10	.35	.08	.51	—
Phosphoric Acid.....	trace	trace	trace	trace	none	none	CO_2 .28	—
Organic Matter	—	—	—	—	trace	trace	—	—
Combined Water	21.87	29.27	24.00	23.39	27.13	18.53	26.35	12.67
	100.00	99.97	99.91	100.08	100.03	99.97	100.01	99.80
Fe_2O_3 on 15 pts. Al_2O_3...	.130	.43	1.31	4.92	.32	.54	.68	.11

NOTE.—These analyses show the iron to exist in the ferric state, excepting the China clay. Both "alum clay" and "bauxite," as supplied by the respective companies, contain varying quantities of ferrous and ferric oxides.

principally with "bauxite." A process invented by the former of these gentlemen deserves notice, not only on account of its ingenuity, but also as the outcome of much exhaustive experimenting. Mr. Kynaston mixes the raw ground bauxite into a thick cream with water, and adds from 5 to 10 per cent. of its weight of oxalic acid together with an equal quantity of hydrochloric acid to prevent the formation of insoluble oxalates. The mixture is allowed to remain at rest with occasional stirring for a week or ten days. A large proportion of the iron goes into solution as oxalate, as also some of the alumina. The oxalates, etc., are removed from the bauxite by adding water and washing by decantation, and from the liquors the oxalic acid is recovered for use again by adding milk of lime in sufficient quantity to precipitate it as insoluble oxalate of lime, but not in such excess as to neutralise the hydrochloric acid present, which retains the iron in solution. The oxalate of lime after being washed is decomposed by boiling with an equivalent of sulphuric acid. Bauxite thus purified is said to produce

heated to a high temperature in order to expel all or nearly all the combined water. It is then ground, and if a high yield of soluble alumina be desired, it should be passed through a fine sieve and the sieved portion alone used.

SULPHATE OF ALUMINA FROM CHINA CLAYS.

Aluminous Cake.—One of the earliest and most successful attempts to introduce to the market a crude sulphate of alumina was made in 1855, by Mr. H. D. Pochin of Manchester. In that year Mr. Pochin obtained a patent for a preparation called by him "aluminous cake," made by heating together oil of vitriol and well-calcined finely-ground China clay. Since that time, and more especially since the patent right has expired, aluminous cake has been largely manufactured in many of the centres of industry in this country, and has found great favour amongst a certain class of consumers. It is one of the best and cheapest sources of sulphate of alumina obtainable by the paper maker, and in consequence

has been, and is now, largely consumed in this industry for sizing purposes.

The following analyses (three distinct makes of this article) show its general composition :—

	No. 1.	No. 2.	No. 3.
	Per Cent.	Per Cent.	Per Cent.
† Alumina.....	12.30	11.51	11.51
Ferric Oxide.....	.05	.16	.21
SO ₃	29.55	28.00	28.38
Lime.....	.10	.12	.15
Free Acid.....	.40	.50	1.83
Insoluble Matter.....	26.50	22.10	20.08
Water, MgO, Loss, etc. ..	31.10	37.28	37.81
	100.00	100.00	100.00

These analyses, when compared with others of crude sulphate of alumina, reveal a low percentage of Al₂O₃, with also a quantity of iron, which renders aluminous cake unsuited for many purposes. The amount of ferric oxide does not, however, interfere with the application of the salt in the paper industry, which practically consumes the whole of it produced in this country as a sizing material in the manufacture of cheap printing and other papers. It invariably contains free sulphuric acid, and often more than traces of arsenic. The insoluble matter, consisting of free silica and undecomposed clay, has a commercial value corresponding to its equivalent in pure China clay, because in the paper industry it serves as a loading material, and, therefore, it cannot be looked upon as an impurity.

As aluminous cake is made almost entirely for paper makers, it will be instructive to point out the essentials belonging to a good article, considered from a paper maker's point of view. It should be perfectly homogeneous, of a good colour, easily soluble, contain no gritty matter, no dirt, little or no free acid, and of course as much soluble alumina and as little iron as possible. The presence of lime as sulphate is not desirable. When it contains gritty matter, it acts injuriously on the press and other rolls of the machine; whilst if free acid be present in large quantity, and has not been properly neutralised by the rosin-soap added to fix the alumina, the acid liquor corrodes the knotted plates and fine wire cloth, upon which the paper is made, besides deteriorating the fibre, the felts of the machine, and acting injuriously on the drying cylinders. These are only a few of the evils caused by the presence of this and other impurities.

The care with which the manufacture of aluminous cake is conducted has given it a foremost place amongst sources of sulphate of alumina for makers of low qualities of papers. In point of cheapness and of purity it can hold its own with its substitute, aluminous-ferric cake; and as it has been in daily consumption in large quantities during the past thirty years, it will be very difficult to entirely displace.

Its manufacture is very simple, involving only one real chemical operation. China clay, as free from grit and iron as possible, is taken and calcined in a

reverberatory or muffle furnace, to expel the combined water, and after being withdrawn and cooled it is ground to a fine powder, and then sieved. The ferrous iron is, during the calcining operation, oxidised to the ferric state. The fine clay is then mixed with an equivalent quantity by weight of oil of vitriol of sp. gr. 1.615 (123° Tw.) in a lead-lined vessel, enough water being added to reduce the strength of the oil of vitriol to about 75° Tw. The mixture is heated slightly, when a violent chemical action soon takes place, 75 per cent. of the alumina and practically all the iron contained in the clay combining with the sulphuric acid to form soluble sulphates. Preferably the mass is kept hot till nearly all the acid has been saturated. When cool, it is ground into coarse fragments, and in this state sold. The proportion of acid and clay should in each operation be accurately measured, in order to produce a "cake" of regular composition. It is quite possible, by having the clay fine enough, and by continued heating with a slight excess of sulphuric acid, to obtain 85 per cent. of the alumina of the clay in the soluble form. This high figure is seldom obtained in practice. The "cake" contains all the impurities of the clay and sulphuric acid.

Commercially pure sulphate of alumina, and also the salt containing a small percentage of iron, may be manufactured from the liquors obtained by diluting with water the aluminous cake formed as described above, settling out the insoluble matter, and treating the clear liquors with some reagent for the partial or complete separation of the iron; but whether these processes are carried out industrially I am unable to state. The earliest attempt to accomplish this object was made about the year 1839, by Weismann, who in May of the following year obtained a patent entitled "Improvements in the Manufacture of Alum." His process consisted in adding ferro-cyanide of potassium to the clear sulphate of alumina liquors obtained from China clay, and containing iron; allowing the Prussian blue thus formed to settle, and finally boiling down the supernatant liquors. A few months later (in December, 1839), Robt. Hervey applied for a patent which was granted in 1840, for "Certain Improvements in the Mode of Preparing and Purifying Alum, etc., and the Application of such Improvements to the Purposes of Manufacture." Hervey's process is substantially the same as Weismann's, only his claim covers all combinations of ferro-cyanic acid. Seventeen years later Metcalf patented the same application.

The precipitation of the iron by ferro-cyanides is so marked a reaction, that at first sight it appears as the solution of the difficulty. The Prussian blue, however, is very difficult to completely settle, even after long standing, and unless its separation is complete the final product is coloured, which renders it quite unsaleable. Owing to this difficulty, it seems doubtful whether any of the foregoing processes have been carried out in practice. The separation of Prussian blue from aluminous liquors was not made a thorough practical success until about six years ago, when Mr. Kynaston, of St. Helens, succeeded in accomplishing it, simply and effectively.

SULPHATE OF ALUMINA FROM IRISH HILL "BAUXITE" AND EGLINTON "ALUM CLAY."

On the introduction of Irish hill bauxite about ten years ago to makers of salts of alumina, a great impetus was given to chemical research in this direction, chiefly because (apart from the growing importance of the pure salt) it contained a larger proportion of iron on 100pts. of alumina than what

* No. 1 is exceptional in purity, the low percentage of Fe₂O₃ being unusual.

† Equal to Al₂(SO₄)₃, No. 1, 41.07 per cent.; No. 2, 38.53 per cent.; No. 3, 38.53 per cent.

was usually found in China clays, and also because it contained such a large percentage of alumina, existing in great part as hydrate, that it presented itself as a cheaper and more convenient source. Not long after Mr. J. W. Kynaston, by much patient and laborious research, invented a process for the removal of the greater part of the iron as arsenite of peroxide, and, somewhat later, by applying Weismann's or the ferro-cyanide reaction, with certain improvements to the thus partially-purified liquors, he succeeded in producing a product which for purity was everything to be desired. Other workers came rapidly forward with inventions. Newlands, Semper, Spence, Kynaston again; and now the chemical activity has not ceased, judging from the list of applications for patents which appear in our Journal. In most cases detailed accounts of these processes have already been published, and it will be unnecessary to give a lengthy description of them. A short *resumé* of chemical principles involved in the most important of them will, I hope, prove interesting.

Starting with "bauxite" or "alum clay" and oil of vitriol, the first chemical operation is the formation of crude sulphate of alumina, and second, the purification of the crude aluminous liquor. Under the first head it will be convenient to treat of aluminoferric cake.

1st. The dissolving operation:—The apparatus required for this purpose is a large wooden or cast-iron tank fitted with a mechanical agitator, which is driven in any convenient way. Both vessel and agitator are protected by a covering of lead. A lead plug and seat are provided in the bottom of the vessel, so that the charge when finished may be run off. A plentiful supply of water must be near at hand, and also a small open steam pipe dips into the tub nearly to its bottom, so that the charge may be heated when necessary.

Into this vessel there are run about 67cft. of oil of vitriol of sp. gr. 1.615 (123° Tw.) cold, and after heating slightly by the injection of steam, there are added about twenty hundredweights of "bauxite" or of "alum clay." After a short time a violent chemical action sets in with the evolution of much heat, causing the mass to swell and rise in the vessel. When this has nearly ceased more bauxite or alum clay is added, in portions of about two or three hundredweights at a time. After each addition the chemical reaction is renewed, and in this way maintained until thirty hundredweights or so of the aluminous material has been added. A quantity of water is added to prevent the mass from "setting," and steam is injected until all or nearly all the acid has been saturated with alumina. Finally, it is diluted by the addition of cold water until it registers a density of about 40° Tw., and is run off into settlers, where the insoluble matter is allowed to deposit. The clear, cool sulphate of alumina liquor contains fully ninety per cent. of the alumina and iron originally contained in the bauxite or alum clay. It will show a density of about 37° Tw. when cold, and assuming first quality bauxite to have been used, will yield on analysis about 400 grammes of real $\text{Al}_2\text{S}(\text{SO}_4) + 18\text{H}_2\text{O}$, with which are associated from 2.0 to 2.5 grammes of metallic iron. The iron exists partly as ferrons and partly as ferric salt. There is always present a quantity of free acid amounting to seldom more than three grammes per litre, which represents about 1.75 per cent. of the total acid used; as also all the arsenic contained in the acid, and any lime, magnesia, and (if any) alkalis of the aluminous material.

The following is an actual analysis of one of these liquors made from first quality bauxite and ordinary arsenical oil of vitriol:

Sp. gr. = 1181 = 36.2° Twaddell.

Grammes per Litre.

$\text{Al}_2\text{S}(\text{SO}_4)$	= 193.12	= 57.92 grammes Al_2O_3
$\text{Fe}_2\text{S}(\text{SO}_4)$	= 1.80	= 1.791 Fe.
FeSO_4	= 3.52	
Free acid	= 1.57	
CaSO_4	= 2.60	
Water	= 977.13	

1180.13

Total solids by actual test, including free acid = 203.03 grammes.

Alumino-ferric Cake.—In 1875, the Messrs. Spence, of Manchester, obtained a patent for the manufacture of a crude sulphate of alumina, technically termed by them "alumino-ferric cake." This product has for a considerable time been produced by them in large quantities from the purer varieties of alum clay or bauxite, by dissolving these in oil of vitriol as described above. The crude aluminous liquor is roughly settled and boiled down to a suitable density, run off into trays to solidify, and the hard mass crushed into fragments, or sold in slabs. Thus manufactured, the "cake" has a brownish-grey colour, due to the presence of insoluble matter and contains all the impurities of the oil of vitriol, as also a very large proportion of the iron, etc., of the aluminous material. Free acid is always present. The insoluble matter exists in a very finely divided state and always in appreciable quantity.

Alumino-ferric cake was introduced as a cheap aluminous compound for the purposes of sewage defecation, and also as a substitute for aluminous cake in the paper industry, with which it differs in containing invariably a greater percentage of sulphate of alumina and practically no insoluble or "loading" material. It is largely used in this country and abroad for sizing purposes in the paper manufacture, and is in every way adapted for the production of every variety of low class papers.

The following is an analysis of alumino-ferric cake:—

Alumina.....	= 14.26	= 47.61 $\text{Al}_2\text{S}(\text{SO}_4)$
Ferric oxide	= .28	
Ferrous do.	= .32	= .64 Fe_2O_3
SO_3	= 35.36	
Free acid	= .45	
Insoluble	= .06	
Water loss, etc.,	= 19.10	

99.83

2nd. Purification of the crude S/alumina liquors. Much ingenuity and chemical skill has been brought to bear on this subject, and within the past six years as many processes have been invented, which appear to be perfectly successful commercially. They may conveniently be divided into two classes—namely, mechanical and chemical. By the former is meant those processes which seek to attain the end in view by mechanical means alone, whilst by chemical processes are meant those which by applying to the ferro-aluminous liquor a chemical reagent precipitate the iron.

1. *Mechanical Process.*—As far as I am aware, there is only one mechanical method in use on the large scale, invented by Mr. B. E. R. Newlands, in 1880, and is at present worked on an extensive scale by Mr. W. G. Strype, in the Dublin and Wicklow Chemical Company's works at Wicklow.

The crude aluminous liquor obtained directly by the action of oil of vitriol on bauxite or alum clay is perfectly settled, the free acid not being neutralised in any way, and is boiled down in lead-lined vessels to a density of 67° Tw. at its boiling temperature, at which strength it is run off into shallow lead-lined vessels to cool. About sixty per cent. (at most) of the total sulphate of alumina in the charge crystallises out in the form of flat scales, containing eighteen equivalents of water per equivalent of alumina.

lent of Al_2O_3 , the other forty per cent., together with all ferric and ferrous sulphate, remaining in solution as mother-liquor. The crystallised mass is broken up in any convenient way, and the resulting "magma" pumped or otherwise forced, with a pressure gradually rising till it equals about 200 lbs. per square inch, into a filter-press of special construction, the individual plates of which are covered with thick felt. In this way a hard cake of $\text{Al}_2\text{O}_3 + 18\text{H}_2\text{O}$ is obtained containing about 145 per cent. Al_2O_3 , and quantities of iron and water, in direct proportion to the amount of mother-liquor not removed.

A second and third crop of crystals are obtained from the first and second mother-liquor respectively, by concentrating and treating the magma from these in the same way as described for the first liquor. These two crops (second and third) contain a larger proportion of iron on the Al_2O_3 , than the first crop, but still very much less than what prevails in the original liquor, to which they may be added whilst this is being boiled down. By so doing, the liquor is enriched, and a purer first crop is obtained. The mother-liquor from the third crop is boiled down to a suitable density and solidified.

There are four distinct qualities of sulphate of alumina which can be made by this process, the three higher qualities corresponding to the three crops of crystals, and the lowest quality to the refuse liquor. By the kindness of Mr. Strype, of Wicklow, I am enabled to give the amount of iron on 1535 parts of Al_2O_3 or 100 parts $\text{Al}_2\text{O}_3 + 18\text{H}_2\text{O}$ in the different pressings, etc. :-

Original Bauxite Liquor.	1st Crop.	2nd Crop.	3rd Crop.	Residue.
Fe_2O_3 on 1535 parts Al_2O_3 ...	0.679 ..	0.065 ..	0.130 ..	0.259 ..
				2.312

It is interesting to observe the gradual increase in the amounts of iron in the various crops as the liquors are subjected to the concentrating and pressing operations. In the *first crop* of crystals the Fe_2O_3 is reduced to one-tenth the amount existing in the crude liquor. In the *second crop* the Fe_2O_3 , reckoned on the same basis, is twice the amount of that in the first crop, or, practically, one-tenth that contained in the mother-liquor from which it is obtained; and the amount of iron in the *third crop* is four times that of the first crop, twice that of the second, or one-tenth that of the mother-liquor from which it was obtained. The residue represents about 20 per cent. of the total alumina in the original liquor. From these figures it is evident that of 100 parts of sulphate of alumina in the original liquor, 80 parts are obtained in three crops, having an amount of ferric oxide representing about 15 per cent. of the original quantity. The other 85 per cent. of iron remains, of course, in the refuse liquor. Moreover it appears that the yield of sulphate of alumina in each pressing does not much exceed 50 per cent. of the total amount operated upon.

By using the finest, or Gertrude quality of bauxite, or any aluminous material equally free from iron, a sulphate of alumina can be made by this process containing not more than .04 per cent. Fe_2O_3 , but this amount is far too great to allow it to compete with the ordinary alums as a mordant in the dyeing and calico printing industries, and for this reason it may be called an imperfect process, as only 90 per cent., at the very most, of the purification can be accomplished.

2. *Chemical Processes.*—Of the chemical methods, the first which demands priority of place is that invented in 1879 by Mr. J. W. Kynaston, and to which I have already referred. It may be called

(a) *The Arsenic Process.*—It consists in precipitating the iron as arsenite of peroxide. The arsenious

acid used for this purpose is ground and mixed with a portion of the bauxite, along with which it is added to the batch in the dissolving vessel shortly after the vigorous chemical action between the aluminous material and sulphuric acid has begun. The arsenious acid goes into solution, and after the batch has been diluted with water to 40° Tw., and the ferrous iron has been oxidised by the addition of NaClO_3 or a hypochlorite, chalk, previously made into thick cream with water, is added in sufficient quantity to neutralise any free acid and to render the liquor basic. It is then run off into a large lead-lined vessel and allowed to settle. When perfectly cold, or after standing a few days, a sample of the clear yellow liquor is taken, and chalk added, when, if a deepening of the tint be observed, due to the formation of the arsenite, more chalk is added to the bulk of the liquor in the tank. Successive additions of chalk are added from time to time until all the arsenite that will separate has been thrown down. In twelve or fourteen days 90 to 95 per cent. of the iron will separate out, leaving a clear, supernatant liquor of a slightly yellow tint, containing a small quantity of arsenic. This latter is removed by running the liquor off into a stone tank and treating with calcium sulphide, the arsenic being of course precipitated as sulphide. When this has settled, the liquor produces by continuous evaporation a sulphate of alumina said to contain from 0.05 to 0.06 per cent. metallic iron.

Shortly after this invention was patented, Mr. Kynaston, seeking to produce a product which should be perfectly free from iron, applied Weismann's, or the ferro cyanide reaction to the liquor after settling out the bulk of the arsenite of peroxide of iron, but encountered the difficulties in completely settling out the Prussian blue previously mentioned. These were entirely overcome by adding a slight excess of ferrocyanide, and after settling a day or two introducing a few pounds of a zinc or a copper salt (preferably sulphates), not only to remove the excess of ferrocyanide, but also to agglutinate, as it were, the blue precipitate which, without such addition, persistently refuses to settle out. The liquor, after being further purified (from As and Cu or Zn) by treatment with CaS , was then boiled down to such a density as to yield on cooling a sulphate of alumina containing 16 per cent. Al_2O_3 , and pure enough to compete with the best ammonia and potash alums. The ferrocyanide used in this process is recovered as the calcium salt by boiling the well-washed Prussian blue with excess of milk of lime.

(b) *Binoxide Methods.*—To Messrs. Semper and Fablberg, I believe, the honour is due of having first introduced to makers of salts of alumina the use of a binoxide for the purpose of removing ferruginous contaminations from aluminous liquids. (See this Journal, vol. i. 275.) In 1882 these gentlemen patented the application of binoxide of lead for this purpose, and somewhat later Kynaston and Spence almost simultaneously that of binoxide of manganese. There is a distinct difference between the last two. Mr. Kynaston claims manganite of hydrogen, whilst Spence claims binoxide of manganese in whatever way produced. Laboratory experiments will easily prove that the hydrated binoxides are alone applicable.

It will be convenient to treat of these processes together, for when working them the chemical conditions to be fulfilled in each case, in order to yield the best results, are almost, if not, identical. They are these: The crude aluminous liquor must not contain free acid, but should be decidedly basic—basic at least to the extent of the sulphuric acid in combination with the ferric oxide. The iron should exist in the ferric state. Especially is this last condition

important in the case of the manganese process, for as Mr. Kynaston points out in his specification, if ferrous iron be present in the liquors along with manganite of hydrogen, it is oxidised at the expense of an equivalent quantity of MnO_2 , the resulting manganous oxide entering at once into solution as sulphate; and in order to free such liquors thus contaminated they must be subjected to another chemical operation. (This Journ. ii. 482.) Any lead which may go into solution in the lead process for the most part separates out during the concentration of the liquid as insoluble PbSO_4 .

Much of the success of these processes depends upon the care with which the hydrated binoxides are prepared.

Preparation of Hydrated Binoxide of Lead.—Dr. Fahlberg recommends that the hydrated binoxide of lead is best prepared by grinding together ordinary litharge PbO and common salt into a thick cream with water and allowing to remain for some time. A basic lead chloride is formed which is decomposed by the addition of a clear solution of bleaching powder, and when the resulting hydrated binoxide of lead is washed free from soluble chlorides it is ready for use. It should not be heated, as it loses its water of hydration, rendering it inactive.

Preparation of Manganite of Hydrogen.—Mr. Kynaston finds this already formed in the "manganese mud" of the late Mr. Walter Weldon's process, and recommends its preparation by treating the mud with a dilute acid (HCl , I presume) in order to remove the "bases," lime, and manganous oxide, which, together with hydrogen, are in combination with the MnO_2 . By so doing he renders the separation of these bodies easy. By simple washing they are removed, and when the manganite of hydrogen is perfectly free from MnO it is ready for use. There are other methods for the preparation of this reagent which will suggest themselves to the technical chemist.

Treatment of the Ferro-aluminous Liquids.—The operation of removing the iron from these liquors is performed by simply adding either of the binoxides, and agitating for some time until a sample withdrawn filtered and tested shows no iron reaction with ferrocyanides. When this is attained the binoxides are allowed to settle perfectly, and the clear liquor drawn off and further treated for the production of solid sulphate of alumina. In the manganese process should any Mn go into solution, Mr. Kynaston recommends its removal by precipitating it as MnO_2 , with free chlorine or a hypochlorite.

Recovery of the Binoxides for use again.—Both are recovered by first washing free from aluminous salt, and then treating them in the cold with a dilute acid—e.g., sulphuric acid. The iron which was in combination with the binoxides goes into solution as sulphate, and is removed from the revived binoxides by washing with water.

There are two other oxy-acids which have been proposed, and which are capable of performing the same work—namely, stannic and antimonic acids. The former of these is perhaps not admissible on a manufacturing scale, where large quantities of iron are to be removed principally on account of its great cost, and although it is quite capable of effecting the desired result, for this reason it will be unnecessary to treat of it further. Not so, however, with antimonic acid, the cost of which is one-third at most that of stannic acid. The manner in which these are used is identically the same as in the "manganese" and the "lead" processes.

From experiments which I have made recently with antimonic acid, and in which I have endeavoured to follow the lines that would suggest themselves to the manufacturer, not only in preparing the purifying

agent, but in its application, I find that it does the work with great rapidity, and as it is fairly stable it maintains its power during successive operations. As the atomic weight of antimony is considerably less than lead, I expect to find on further investigating this subject that antimonic acid will prove as cheap a material as peroxide of lead.

Thus far I have endeavoured to give a short account of the methods proposed within recent times for freeing aluminous liquors from iron, and it only remains to add a word or two in relation to these processes in general.

Of them all Mr. Kynaston's "manganese" process is obviously the cheapest, because the manganite of hydrogen is already formed in the source from whence he obtains it—viz., Weldon's "manganese mud," and also because manganese in the form of oxide is the cheapest available material. It is a process, however, which apparently requires much care and attention if the contamination of the liquors with manganese is to be avoided, and I venture to think in this respect differs from the other processes. This difference, however, is only one of degree, and not of kind, inasmuch as over all of them careful chemical supervision is necessary for successful work. In the "lead" process, should any lead go into solution it may be removed along with the arsenic derived from the oil of vitriol by precipitating both of them as sulphides with calcium sulphide, and the same is true of the antimony process should antimony go into solution. Products of equal purity can be made by the use of any of these oxy-acids.

When properly prepared, the relative amounts of hydrated binoxides required to remove one unit of iron bears such a relation to their relative molecular weights as would lead one to believe that the chemical compounds they form with ferric oxide correspond in constitution the one with the other. It is plain, therefore, that the amount of plumbite of hydrogen required in the "lead" process is greater than the amount of manganite of hydrogen required in the "manganese" process to remove equal quantities of iron. The exact constitution of the compounds which they severally form with the ferric oxide is not known. I have lately performed several experiments with all these oxy-acids in order to elucidate this point, with results which are not sufficiently uniform to warrant a definite statement.

None of these oxy-acids are stable enough to serve for an indefinite number of purifications, all of them becoming inactive after repeated use. This is owing principally (and only as far as I am aware) to dehydration, the iron hydrated compound being perfectly useless for the purpose in view. The item of cost of purification, therefore, is influenced not alone by the relative first cost of these oxy-acids, and by the amounts of mechanical loss always existing in manufacture operations, but also by their relative degrees of stability. The MnO_2 , after its purifying power has been spent, is still suitable for the production of chlorine, and probably no such useful value can be attached to either peroxide of lead or antimonic acid. The PbO_2 and Sb_2O_5 may of course be sold as such.

The arsenic and ferrocyanide method differs from these processes chiefly in the length of time required to completely remove the iron. Arsenite of peroxide of iron and Prussian blue are precipitates of a very light and flocculent nature, and they take a long time to completely settle. Mr. Kynaston himself states a month. This is not so in the oxide methods, the sulphate of alumina in which need not be more than a week in process. Hence there is a saving of plant in these oxide processes when compared with the arsenic and ferrocyanide method.

Of Newland's process, as I have previously stated, it may be said to be an imperfect one when compared with the chemical methods, as no sulphate of alumina can be made from it free from iron. The product, however, is very suitable for many purposes, and although the separation of the iron is not complete, and rather a large proportion of the original alumina is obtained in a very impure form, yet by it a product is made in a few days pure enough to satisfy the demands of many consumers as cheaply, I believe, as any of the other methods. Beyond this it is an interesting process, inasmuch as it is, I believe, the first mechanical one worked in this or in any country.

The following are analyses of sulphates of alumina:—

	NEWLAND'S			PURE SALTS.		
	Extra Quality.	Ordinary quality.	No. 1.	No. 2.	No. 3.	No. 4.
Al ₂ O ₃	11'84	11'70	11'95	11'85	16'00	16'20
Fe ₂ O ₃	'06	'12	'016	trace	nil.	trace
SO ₃	35'00	34'60	36'09	34'91	38'00	38'00
Free Acid.....	'32	'40	nil.	'29	nil.	nil.
Lime	'11	'11	'17	'11	'16	'11
Water	49'42	49'95	48'72	49'60	45'50	45'40
	99'75	99'88	99'97	99'82	99'66	99'74

The samples of Newland's process were kindly sent to me by Mr. Strype for analysis. No. 2 contained a notable quantity of manganese, which plainly reveals its origin. No. 3 is made by Mr. Kynaston's "arsenic and ferrocyanide" process, and is remarkably pure in every way. Not a trace of iron can be observed in it with the sulphocyanide of potassium test, which I think shows the great skill, ability and perseverance which he has shown in working out one of the most tedious processes, in my opinion, known to chemical technologists.

In conclusion, I have to thank Mr. George Blackwell, of the Irish Hill Bauxite Mining Co., for the samples of bauxite; and also Mr. W. J. A. Donald, of the Eglinton Chemical Company, for the samples of alum clay which they have kindly sent for exhibition.

DISCUSSION.

Mr. A. E. REED: I should like to ask Mr. Beveridge why he gives preference to aluminous cake before aluminous-ferric cake, for when the former is bought the value of it depends upon the amount of anhydrous sulphate of alumina it contains.

Mr. BEVERIDGE: In order to arrive at the real value of the sulphate of alumina found in aluminous cakes the value of the *loading material* or insoluble matter should be deducted from the cost of these, as this insoluble matter serves the same purpose as China clay in the paper industry.

The CHAIRMAN asked whether hydro-extractors had not been used in Newland's process for separating the mother-liquor from the crystallised S/alumina, and also referring to the chemical processes, if the oxides (MnO₂ and PbO₂) were dissolved by the aluminous liquor. Mr. Beveridge, in reply, stated that "hydros" had been tried, but he believed without success. The oxides were not dissolved unless a reducing agent was present.

Mr. R. W. ATKINSON said that although Mr. Beveridge had made no mention of the analytical

method employed in determining the alumina in his samples, it might be interesting to the members to describe a volumetric process recently proposed by Dr. Bayer in the *Zeitschrift für Analytische Chemie*. This process was based upon the fact that whilst sulphate of alumina was acid in its reaction to litmus, it was neutral to tropeoline. Hence, when an alkaline solution of alumina was coloured with litmus, the red colour appeared as soon as the alkali was neutralised, and sulphate of alumina commenced to be formed. When, however, tropeoline was used, the acid indication occurred only when the alumina first precipitated was completely redissolved. Thus the difference between the two amounts of standard acid used was a measure of the amount of alumina present. The speaker had found that litmus was not sufficiently sensitive, but that if it was replaced by phenol-phthalein the results were fairly accurate, and quite sufficiently so for practical purposes. The method undoubtedly had the advantage of simplicity and rapidity, and for technical purposes might well replace the tedious gravimetric method. Mr. R. T. Thomson had previously indicated a similar method, but had not thoroughly worked it out as an analytical process.

Mr. PRINGLE: For some time past I have been using a somewhat similar method to the one Mr. Atkinson refers to, for the estimation of *free acid* (sulphuric) and *iron* in the *pickling liquor* used for cleansing sheet-iron plates before tinning. The two indicators I use are litmus and phenol-phthalein. To a measured quantity of the pickling liquor I add caustic soda solution till the iron begins to precipitate, or until the litmus is coloured blue. The amount of soda taken is a measure of the free acid present. The iron may be estimated in the same solution by adding the caustic soda standard in slight excess, using phenol-phthalein as indicator. This method I have found to give quick and reliable results.

Journal and Patent Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Improvements in Filters. E. M. Knight, Liverpool. Eng. Pat. 13,782, October 18, 1884.

Two perforated cylinders are placed concentrically in a containing vessel; the innermost cylinder is covered with asbestos cloth, and the space between the two packed with charcoal. The water is filtered from the container into the inner cylinder, which may further be furnished with an ice box, emerging therefrom by a pipe at the lower part of the apparatus. Sometimes the unfiltered water is admitted into the inner cylinder first, and the flow of filtered water is in the reverse direction.—C. C. H.

Improvements in Machinery or Apparatus for Refrigerating and Producing Ice, and in Liquid for the purpose. S. A. Varley and W. A. Gorman, London. Eng. Pat. 16,649, December 18, 1884.

This invention refers to the class of apparatus in which a carrying fluid, such as ammonia, which boils at a low temperature, is subjected to a partial vacuum for the purpose of lowering its temperature by evaporation, and then made to circulate through spaces which are surrounded by the liquid to be cooled. The production of the partial vacuum, as also the movements of the cooling liquor, are brought about by the expansion and contraction of two India-rubber tubes of special construction. These are placed concentrically in a closed

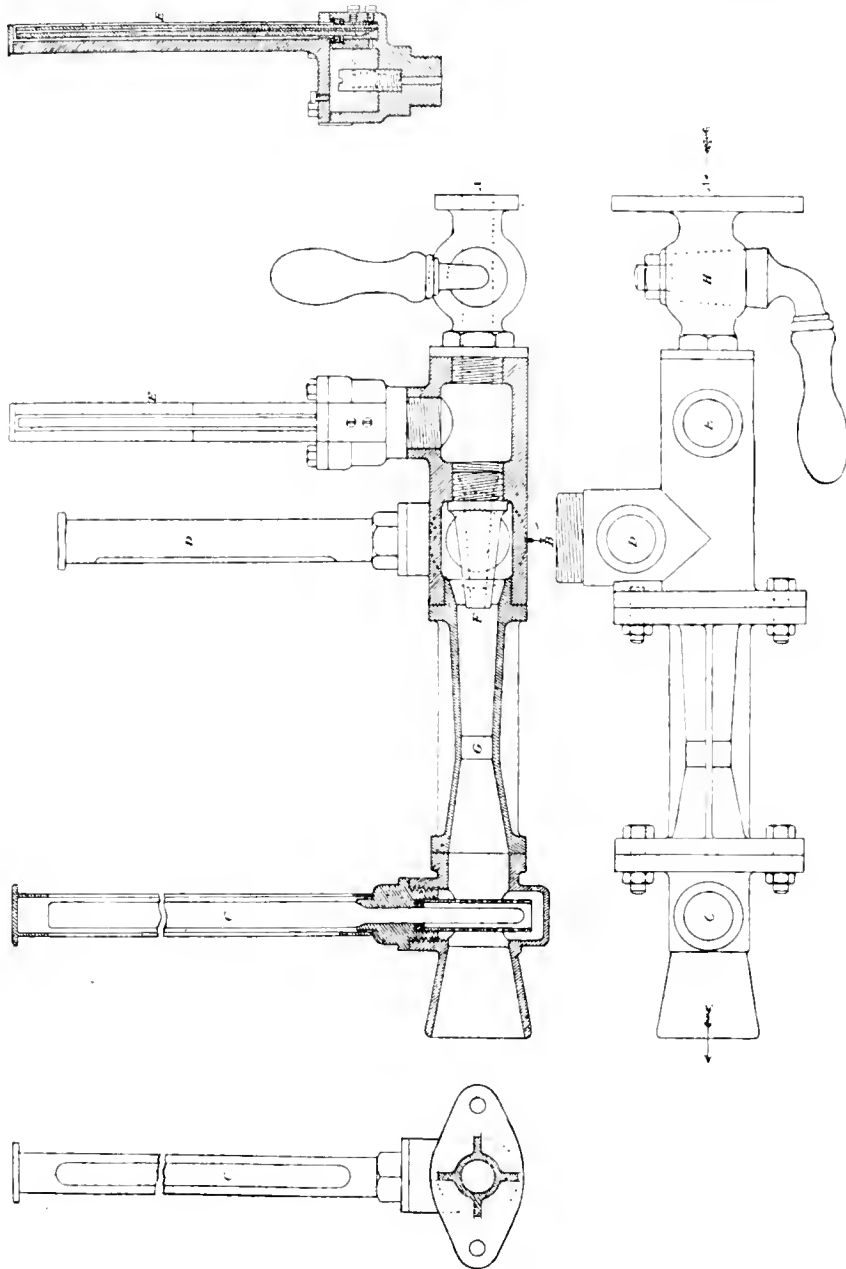
chamber, around a rotating shaft which carries rollers that pass over and close the tubes progressively whilst rotating, thus pushing the air and liquor before them. For fuller details, the printed specification and drawing must be consulted.—B.

Improvements in Filters. G. Haycraft, Lyme Regis.
Eng. Pat. 590, January 15, 1885.

THE patented improvement refers principally to the use

Description of Hot Blast Pyrometer (Krupp's Patent).
A. von. Bergen, Darlington. Journal Iron and Steel Inst., 1885.

THIS instrument will be understood from the illustration below. The hot blast enters at A, its pressure is regulated by cock H to a constant quantity, indicated by gauge E. Cold air is drawn in at B, the temperature of which is indicated on thermometer D. The gases mix in G, and, emerging from the apparatus, register their temperature on thermometer C. It is first necessary to obtain a co-efficient for the instrument by an absolute



KRUPP'S PATENT PYROMETER.

of a fibrous compressed filtering material, in the shape of flat discs of any form, held together in cases in such a manner as to produce tight joints around the edges of the discs with the view to preventing unfiltered water from finding its way into the interior or through the filtering material.—B.

determination of the temperature of the hot blast by means of Siemens's copper ball pyrometer, thus—

$$C = \frac{H - A}{F - A}$$

where C is the co-efficient, H temperature of hot blast, A that of cold, A and F that of the mixture. Having obtained this constant, the temperature of the blast may be found from the readings and the equation $H = C(F - A) + A - C. C. H.$

Improvements in and Apparatus for Evaporating and Concentrating Liquors and Depositing their Contents. G. S. Hazlehurst, Rhyl. Eng. Pat. 973, January 23, 1885.

THIS invention refers to apparatus for evaporating liquids and obtaining their crystals or deposits by means of movable endless surfaces of net, meshes, or strands, over which the liquor is allowed to spread, heat being applied underneath the chamber in which the apparatus is erected. The arrangement may consist of a number of parallel rollers, one series at the top and a corresponding series at the lower end of a vertical heating chamber, over which an endless net is laid and made to travel continuously. Above the upper rollers a series of tanks is placed, out of which the liquid drops and spreads upon the net, and is evaporated on its way by heat ascending from hot plates underneath. There are devices for detaching and collecting the resulting salts and deposits, for changing speed, for adjusting the net, etc., etc.—B.

Improvements in Capillary Filters. J. C. Newburn, London. From J. A. Tupper, Salt Lake City. Eng. Pat. 1489, February 3, 1885.

THE inventor makes use of capillary action for the purpose of filtration by arranging a number of tubes to project upwards from, and to pass downwards through the bottom of a vessel containing the liquid to be filtered. Wicks are placed into these tubes, their upper ends passing over the tops of the tubes and dipping into the liquid to be filtered, whilst their other ends project downwards through the tubes, thus acting as syphons. Several vessels constructed in this manner may be superposed one upon the other with the view to any desired number of repeated filtrations.—B.

Improvements in Filters. F. R. Lipscombe, London. Eng. Pat. 1510, February 3, 1885.

THE filter consists of two or more cylinders or other shaped vessels, made of a porous substance, or perforated and only covered with a porous substance. These cylinders are placed one within the other, the intervening spaces being filled in with charcoal or filtering material, either of which, as well as the top and bottom plates, may be removed separately for cleaning. The whole is inserted in a tank, the filtered water being withdrawn from the central or any other part of the filter.—B.

Refrigerating and Ice Machines. W. H. Wood, New York. Eng. Pat. 7824. June 27, 1885.

THIS specification describes various improvements in the mechanical details of vapour liquefaction pumps, and their adjuncts, used in refrigerating. The most important of these improvements consists in lubricating the interior of the cylinder by injecting into the current of vapour fed into the pump a spray-jet of the same vapour previously liquefied. The expansion of this into vapour in the interior of the cylinder greatly reduces, by absorption, the heat which would otherwise ensue from the compression of the vapour in the second part of the stroke. The remaining improvements are fully illustrated and described at considerable length.

—C. C. H.

II.—FUEL, GAS, AND LIGHT.

On the Behaviour of Mixtures of Carbon Dioxide and Hydrogen at High Temperatures. A. Naumann and C. Pistor. Ber. 18, 2724—2727.

IN order to ascertain whether hydrogen exerts a reducing action upon carbon dioxide, and at what tem-

perature this action commences, a mixture of dry carbon dioxide and hydrogen in the proportion of 1 to 3 was passed through a glass tube filled with small pieces of pumice-stone, at a temperature between that of the melting point of lead chloride (501°) and that of lithium chloride (602°). No formation of carbon monoxide took place. In a second experiment, conducted in the same manner at a temperature of 602° to 634°, the same negative result was obtained. Two more experiments were tried at a temperature between 861° and 954°, the gases passing through a porcelain tube of eight millimeters internal diameter. As in the previous cases, no change took place, thus proving that temperatures up to about 900° are insufficient to cause a reduction of carbon dioxide to monoxide by means of hydrogen. This result is supported by the fact that the heat of combustion of carbon monoxide is greater than that of hydrogen (to water in a gaseous form); further, by the great stability of carbon dioxide at high temperatures, no dissociation taking place even at 1700° when the gas is heated by itself, while it only commences to dissociate at 1300° when being passed through a porcelain tube filled with pumice-stone. The water which would be formed by the decomposition of the carbon dioxide by hydrogen would more readily be decomposed, the oxygen again combining with the carbon monoxide to regenerate carbonic acid. Contrary to the above observations, H. Traube (Ber. 18, 1891) found that by the influence of the electric spark upon a mixture of carbon dioxide and hydrogen a diminution of the volume of these gases takes place through the formation of carbon monoxide. Upon moist carbon monoxide, the electric spark remained without influence.—F. M.

Reaction of Carbonic Oxide and Water at High Temperatures. A. Naumann and C. Pistor. Ber. 18, 2894—2897.

A MIXTURE of carbonic oxide and steam (in about molecular proportion) was passed through a heated tube filled with pumice-stone. Below 600° no reaction took place; but at 600° it just commenced. At about 900° eight per cent. of CO₂ were formed, liberating the corresponding quantity of hydrogen from the water; and at about 950° ten and-a-half per cent. of CO₂ were produced.—A. G. G.

Improvements in Apparatus for Carburetting Gas for Lighting Purposes. W. G. Little, Conisboro. Eng. Pat. 17,108, September 30, 1885.

A TUBE, closed at one end and open at the other, contains a rod of solid hydrocarbon, preferably naphthalene. This tube is fastened in a vertical position, with its open end about an eighth of an inch above a horizontal iron plate. The whole is enclosed in a dome-shaped vessel, the bottom of which is the iron plate above mentioned. The gas to be carburetted passes by pipes suitably arranged over this iron plate to the burners situated just below. When these are lighted the plate becomes heated, and is covered by a film of melted naphthalene to the depth of one-eighth of an inch, kept at this depth by the arrangement above described. The gas passing over this film of melted naphthalene is impregnated with the vapour thereof. A suitable tap allows gas, if desired, to pass to the burners without passing through the carburetter.—A. R. D.

Improvements in obtaining Gas for illuminating and other purposes. J. F. Schnell and John Reed, Manchester. Eng. Pat. 690, October 16, 1885.

ATMOSPHERIC air is to be impregnated with the vapours of various compositions, and used for heating or illuminating gas respectively.—A. R. D.

Improvements in Condensing Apparatus for Treating or Purifying Coal Gas. George Love, Manchester. Eng. Pat. 2489, October 22, 1885.

THE gas on leaving the oven, generator, or producer, is led through a chamber where its course is rendered as

circumfous as possible by suitably-disposed screens or trays. In this chamber it is treated with water in jets, or very finely-divided spray.—A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Sylvic and Pimaric Acids. S. Haller. Ber. 18, 2165—2168.

WITH the exception of the percentage composition of sylvic and pimaric acids, the statements of various authorities in regard to the properties of these acids differ to such an extent that the author thought it of sufficient interest to investigate this subject. A supply of these acids in an almost pure condition being at his disposal, the final purification was effected by digesting the material in dilute caustic soda ley of about 3 per cent. strength, in which nearly two-thirds of the mass was soluble. The acids in the alkaline solution were reprecipitated by means of an acid, gelatinous flakes being obtained, which were thrown on a filter, washed carefully with water, and recrystallised. For the crystallisation of the pimaric acid, a large excess of the acid was mixed with hot 60 per cent. alcohol, and the hot solution filtered. On cooling, the acid was deposited in the form of a crystalline mass. The sylvic acid was crystallised from a minimum of alcohol, shining prismatic laminae being produced. The following numbers were obtained by analysis:—

Pimaric acid, C=78.47 and 78.62, H=9.41 and 9.62 per cent.;

Sylvic acid, C=78.85 and 78.65, H=9.78 and 9.62 per cent.

The softening points of these acids were 120° and 145°, and the melting points 149 and 161–162° respectively. The rotatory power of sylvic acid in an alcoholic solution was found to increase after each crystallisation until it became constant at $[\alpha]_D^{20} = -53$. Pimaric acid, when purified as above-described, is optically inactive.

The hydrocarbon obtained by Liebermann from these acids, by treatment with hydriodic acid and phosphorus, was prepared and examined by the author. An attempt was made to obtain numbers agreeing more closely with the formula $C_{10}H_{16}$ than those hitherto found. The results were not, however, sufficiently satisfactory, as can be seen by an inspection of the figures given in the original paper.

The hydrocarbons are optically inactive, and appear to be identical.—D. B.

Presence of Pseudocumene and Mesitylene in different kinds of Petroleum. C. Engler. Ber. 18, 2234—2238.

ABOUT six years ago the author proved the existence of pseudocumene in Pennsylvanian petroleum. Since that time other varieties, such as American, Russian, German, Galician and Italian petroleum have been examined, in all of which cumenes in the form of pseudocumene and mesitylene have been detected. American petroleum was found to contain about 0.2 per cent. of cumenes, whilst Russian petroleum showed only 0.1 per cent. The isolation was effected by digesting the fraction of the oil distilling between 170 and 190°, with a mixture of 2 parts of concentrated sulphuric acid and 1 part of nitric acid, the resulting mass being composed of trinitropseudocumene and trinitromesitylene. To separate these cumenes the mixture was treated with alcohol and heated on a water-bath for several hours. The solution contained the trinitropseudocumene, whilst the residue was composed of trinitromesitylene.—D. B.

Derivatives of Durene. J. U. Nef. Ber. 18, 2801—2807.

Durylic acid is obtained, free from cumidic acid, by heating durene with dilute HNO_3 (1 vol. HNO_3 1.4 to 3 vol. water) for 3–4 hours. The product is dissolved in NaOH, and precipitated with HCl. To free it from

nitro-compounds, it is heated with Zn and acetic acid, and finally distilled with steam.

Dinitrodurylic acid is prepared by dissolving the above acid in strong H_2SO_4 , cooling and then gradually adding KNO_3 . The pure compound is obtained by decomposing the lime salt.

Dinitropyromellitic acid is obtained by the oxidation of dinitrodurylic acid in an alkaline solution with $KMnO_4$. The mass is filtered, acidified and extracted with ether. On distilling off the ether, 2 compounds remain, a tri- and tetra-basic acid. They are separated by adding methylated spirit to the concentrated solution of the lime salts, when the salt of the tetrabasic pyromellitic acid is completely precipitated. The silver salt gave, on analysis, the formula $C_{10}(NO_2)_2(CO_2Ag)_4$. It could not be reduced to the corresponding amido-compound. The ethyl ether, however, on reduction with Zn and acetic acid, yields an azo-body of the formula $C_6N_2(CO_2C_2H_5)_4$, and possessing a deep cinnabar-red colour.

Durenequinone is obtained from diamidodurene by oxidation with sodium nitrite, or Fe_2Cl_6 in an acid solution.—J. B. C.

Derivatives of Durene. O. Jacobson and E. Schnapauff. Ber. 18, 2841—2844.

DURENE, brought in 2½ times the weight of chlorosulphonic acid, forms durene-sulphonic chloride $C_{10}H_{13}SO_2Cl$, and in addition durylsulphone $(C_{10}H_{13})_2SO_2$, and durene-sulphonic acid $C_{10}H_{13}SO_3H$. If the resulting semi-solid mass be treated slowly with ice-cold water, the sulphonic acid may be separated by filtration from the other two compounds. The filtrate is then saturated with NaOH, and the sodium salt crystallises out. Durenesulphonic chloride may be separated from sulphoduride by crystallisation from alcohol and ether. Durylsulphone remains in the mother liquor, and it may be obtained in the pure state by heating with alcoholic NaOH, precipitating with water and crystallising from dilute alcohol. If the sulphonic acid only be required, the residue left, after separating the first portion of the sulphonic acid, is dissolved in alcohol, and heated with an excess of dilute NaOH on the water-bath. Water is added, and the whole mass cooled, when the sodium sulphate separates out, and the durylsulphone may be extracted with ether. These three compounds are crystalline bodies possessing the general properties of their class.

Dureneol $C_{10}H_{13}OH$ is obtained in the usual way by fusing the sodium salt of durenesulphonic acid with KOH. It is a solid body, m.p. 117°. On protracted fusion, hydroxydurylic acid is formed of the formula— $C_6H(CH_3)_3(OH).CO_2H$.—J. B. C.

IV.—COLOURING MATTERS AND DYES.

Isomeric dihydroxydimethylanthraquinones. S. v. Kostanecki and S. Nientowski. Ber. 18, 2138—2141.

IN a previous communication (Ber. 18, 250) it was shown that concentrated sulphuric acid reacts with symmetrical hydroxytoluic acid in the same way as with meta-hydroxybenzoic acid. The product was separated into two portions by the action of baryta water, and from the insoluble residue a dihydroxydimethylanthraquinone was isolated, which the authors described as dimethylanthrarufin. By the action of hot acetic anhydride and sodium acetate *acetyldihydroxydimethylanthrarufin* $C_{16}H_{16}O_2Ac_2$ was obtained. This compound forms yellow plates melting at 236 to 237°. The portion soluble in baryta water was treated with hydrochloric acid, the resulting precipitate washed with water, and extracted with boiling alcohol. The sparingly soluble dimethylanthraflavic acid remains in the residue, whilst the alcoholic solution contains dimethylmetabenzodihydroxyanthraquinone, and a small amount of dimethylanthraflavic acid. *Dimethylanthraflavic acid* $C_{16}H_{16}O_6Me_2$ sublimes in yellow needles, melting at 360°. It is insoluble in benzene, sparingly soluble in alcohol, and glacial acetic acid, and resembles anthraflavic acid in many of its properties. The spectrum is almost coincident

with that of the latter. The alkaline solutions are yellow. Mordants are not dyed by it. The acetyl compound crystallises from alcohol in pale yellow needles, melting at 223°. The isolation of the dimethylbenzodihydroxyanthraquinone was effected by adding lead acetate to the alcoholic solution, filtering and concentrating the filtrate, when yellow needles were obtained, which were purified by extraction with benzene and recrystallisation from alcohol.

Dimethylbenzodihydroxyanthraquinone— $C_{14}H_{10}O_4(CH_3)_2$ —crystallises and sublimes in needles, melting at 213°. It yields a brown solution with concentrated sulphuric acid, the spectrum of which resembles that of metabenzodihydroxyanthraquinone. Its alkaline solutions are golden yellow. The acetyl compound forms needles, melting at 188°. Although the product of the action of concentrated sulphuric acid and symmetrical hydroxytoluic acid is identical with that of metahydroxybenzoic acid, the relative yields of the isomerides differ. Whilst crude anthraflavone produces mainly anthraflavic acid, the chief product from dimethylantraflavone is dimethylanthrarinin.—D. B.

On the Action of Diazo-compounds on β -Naphthylamine, and on α - β -Naphthylenediamine. (Second Communication.) T. A. Lawson. Ber. 18, 2422–2427.

IN a previous paper (this Journal, iv, 395), the author has described some products of the above reaction, which behave partly as diazoamido and partly as amidoazo-compounds, or derivatives of naphthalene with two ammonia residues as side chains. The compound obtained by the action of amyl nitrite on β -naphthylamine belongs to this class, is identical with that obtained by combining diazo- β -naphthylamine with β -naphthylamine, and behaves in the same way as benzenediazo- β -naphthylamine. From this it appears that β -naphthylamine always gives diazoamido derivatives differing in certain reactions from those diazoamido bodies hitherto known.

Reducing agents decompose β -naphthalenediazo- β -naphthylamine into β -naphthylamine and α - β -naphthylenediamine, m.p. 96°. The fact that no hydrazine is produced, and the formation of a naphthylenediamine, points to the preliminary change into amidoazo-compounds, but all efforts to form and isolate these bodies have failed. With aniline and aniline-hydrochloride, the reaction commenced at 100°; traces only of a substance melting at 136° were however formed. β -naphthalenediazo- β -naphthylamine $C_{16}H_7N=N-NH(C_{10}H_7)$ crystallises from alcohol in needles m.p. 149°. Boiled with dilute sulphuric acid this body is decomposed, nitrogen being evolved. The acetyl and benzoyl compounds are sparingly soluble in alcohol and petroleum spirit, easily so in benzene. Treated in acetic acid solution with bromine, these diazo-compounds are decomposed, bibrom- β -naphthylamine is precipitated, bromophenols remain in solution and nitrogen is given off. *Dibrom-naphthylamine* $C_{10}H_7Br_2NH_2$ is a weak base, forming colourless needles easily soluble in alcohol and benzene, m.p. 121°. The acetyl-compound melts at 208°.

The naphthylenediamine hydrochloride obtained on reduction from these bodies reacts with benzaldehyde at 100°, with formation of a base melting at 103° and decomposing at 120°. With phenanthrenequinone, phenanthrene-naphthaquinoxaline is obtained, $C_{12}H_8 : (CN)_2 : C_{12}H_8$, which crystallises from benzene in small yellow crystals, m.p. 273°. They are insoluble in alcohol, and are reddened with HCl. Warmed on the water bath with benzil in alcoholic solution, diphenyl-naphthaquinoxaline, $C_{10}H_6 : (CN.C_6H_5)_2$, is produced, forming light brown plates easily soluble in alcohol and ether. Lellmann's reaction was unsuccessful, but the above reactions prove sufficiently this naphthylenediamine to be α - β or β - β -ortho-derivative. Other experiments show it belongs to the same class as β -naphthoquinone, therefore it is α - β -o-naphthylenediamine, and the same naphthylenediamine is easily obtained from α -nitro- β -naphthylamine.—T. L. B.

Benzylhydroxanthranol. L. Levi. Ber. 18, 2152.

THIS compound is best prepared by adding 5 parts of benzylbromide to a boiling mixture of 5 parts of anthraquinone, 5 parts of zinc-dust and 7.5 parts of potash dissolved in 100 parts of water. The resulting benzylhydroxanthranol $C_{21}H_{16}O_2$ is readily soluble in alcohol, benzene, glacial acetic acid and melts at 146°. It crystallises from benzene in fine white plates. Cold concentrated sulphuric acid converts it into dehydrobenzylhydroxanthranol $C_{21}H_{14}O$. The latter forms long yellow needles melting at 127°.—D. B.

On Mixed Azo-Compounds (II.). E. Bamberger and A. Cahman. Ber. 18, 2563. (See also, 17, 2415.)

THE sodium compound of ethyl-aceto-acetate acts upon the nitrated diazo-compounds forming mixed azo-compounds (Bamberger, Ber. 17, 2415), sodium benzoyl-acetic ether was found to act in a perfectly analogous manner. *Phenylazoacetophenone* $C_6H_5-N_2-CH_2-CO-C_6H_5$ and *phenylazobenzoylelactic acid* $C_6H_5-N_2-CH(COOH)-CO-C_6H_5$. By slowly adding to a well-cooled neutral solution of diazobenzene chloride a solution of benzoyl-acetic ether in an equivalent quantity of caustic soda, a reddish-brown resin separates out, consisting of a mixture of phenylazoacetophenone and phenylazobenzoylelactic ether. By heating this with an alcoholic solution of potash and adding water to the solution obtained the ketone is separated in yellow flakes, while the acid formed by the saponification of the ether remains in solution and is obtained from it by the addition of a mineral acid. *Phenylazoacetophenone* forms golden yellow needles, melting at 128.5°. It is readily soluble in hot alcohol and glacial acetic acid. *Phenylazobenzoylelactic acid* crystallises from acetic acid and dilute alcohol in long lemon-yellow needles, melting at 141°, and is readily soluble in hot ether, alcohol, and acetic acid. By boiling this acid with a dilute solution of caustic soda, phenylazoacetophenone is formed, which separates out in the shape of small crystals. This reaction is analogous to that observed by v. Richter and Münzer (Ber. 17, 1926) and Bamberger (Ber. 17, 2415) in case of the azo-derivatives of aceto-acetic ether.

Ortho-nitrophenylazoacetophenone— $NO_2.C_6H_4.N_2.CH_2.CO.C_6H_5$ [$NO_2 : N_2 = 1 : 2$]-and *ortho-nitrophenylazobenzoylelactic ether*— $NO_2.C_6H_4.N_2.CH(COOH).CO.C_6H_5$ [$NO_2 : N_2 = 1 : 2$]-are prepared according to the method given by the author in his first paper (Ber. 17, 2415). The former crystallises in shining, golden yellow needles, pretty soluble in the ordinary solvents, and melting at 140 to 141°. The latter forms sulphur-yellow, silky needles, readily soluble in hot glacial acetic acid, less in cold acetic acid, alcohol, and ether. It melts at 177°. By heating it to this temperature for some time it is converted into ortho-nitrophenylazoacetophenone.

Meta-nitrotolyl-para-azobenzoylelactic acid— $C_6H_5(CH_3)(NO_2).N_2.CH(COOH).CO.C_6H_5$ [$CH_3 : NO_2 : N_2 = 1 : 3 : 4$]-prepared from meta-nitro-paratoluidine (m.p. 114°) and sodium benzoyl-acetic ether—golden-yellow needles with a silky lustre, melting at 194°.

Meta-nitrotolyl-para-azoacetophenone— $C_6H_5(CH_3)(NO_2).N_2.CH(COOH).CO.C_6H_5$ [$CH_3 : NO_2 : N_2 = 1 : 3 : 4$]-forms lemon-yellow needles, melting at 168° (?). By adding hydroxylamine, and an equivalent quantity of caustic soda to an alcoholic solution of this compound, a ketoxime, crystallising in reddish-yellow needles, and possessing the formula $C_6H_5(CH_3)(NO_2).N_2.CH_2.C(OH).C_6H_5$ [$CH_3 : NO_2 : N_2 = 1 : 3 : 4$] is produced.

—F. M.

Derivatives of Pseudocumenol. K. Auwers. Ber. 18, 2655–2660.

THE methyl-ether of pseudocumenol— $C_6H_5(CH_3)_2.OCH_3$ [$1 : 3 : 4 : 6$]-is a colourless fluid, which boils at 209°–211°.

Monobromopseudocumenol— $C_6H_5(CH_3)_2(Br)OH$ —is formed by bromination of pseudocumenol dissolved in acetic acid. It crystallises in yellow needles, melting at 35°; insoluble in water.

Dibromopseudocumenol— $C_6H_3(CH_3)_3(Br)_2.OH$ [1:3:4:2:5:6]—obtained by further bromination of the preceding, forms long colourless prisms or needles, which melt at 149° , are insoluble in water, but tolerably soluble in alcohol, benzene, and acetic acid, and very easily in ether and chloroform. Its methyl-ether— $C_6H_3(CH_3)_3(Br)_2.OCH_3$ —crystallises from acetic acid in thick white needles, insoluble in water, and melts at 96° .

m-Nitropseudocumenol— $C_6H_3(CH_3)_3(NO_2).OH$ [1:3:4:2:6]—is obtained by evaporating an alcoholic solution of nitropseudocumenolnitric ether— $C_6H_3(CH_3)_3(NO_2).ON.O_2$. It melts at 48° , and is tolerably soluble in hot water, very easily in other solvents. It dissolves in alkalis with a deep-red colour. By dilute HNO_3 it is reconverted into the nitric ether. Its methyl ether— $C_6H_3(CH_3)_3(NO_2).OCH_3$ —forms large transparent prisms, or rhombic tables, which melt at $41-42^\circ$, and is very soluble in all ordinary solvents except water.

Dimitropseudocumenol— $C_6H_3(CH_3)_3(NO_2)_2.OH$ —is formed by the action of NH_3 in ethereal or alcoholic solution on *m*-nitropseudocumenolnitric ether, or better by passing a stream of dry NH_3 gas over the finely-powdered compound. It melts at 112° .

Dipseudocumenol— $C_6H_3(CH_3)_3.OH$ —is best prepared by oxidation of pseudocumenol with a solution of $K_2Cr_2O_7$ in acetic acid, the yield being 50–60 per cent. It is also formed by oxidation of pseudocumenol with Fe_2Cl_6 or dilute HNO_3 . It crystallises in long needles or small hexagonal crystals, and melts at 173° . Its dimethyl ether— $C_{12}H_{15}(CH_3)_6(OCH_3)_2$ —melts at 126° , and is insoluble in alkalis. By bromination in acetic acid solution the dicumyl yields—

Dibromodipseudocumenol— $C_{12}H_{15}(CH_3)_6Br_2(OH)_2$. This forms small glistening crystals, which melt at $186-187^\circ$, are easily soluble in alcohol, acetic acid, and ether, sparingly in alkalis, and insoluble in water.—A. G. G.

On the Amido-azo-derivatives of the Three Xylenes. E. Nölting and S. Forel. Ber. 18, 2681–2686.

Up to now only one amido-azo-xylene was known, which had been obtained by Nietzki from commercial xylene (Ber. 13, 472). The authors prepared the amido-azo-derivatives from the pure xylenes in order to compare them with Nietzki's compound. The latter was found to be a mixed compound, containing meta-xylene in one and para-xylene in the other nucleus (with the NH_2 group).

Amido-azometaxylene— $C_6H_3(CH_3)_2N = NC_6H_4(CH_3)(CH_3)NH_2$. [$CH_3 : CH_3 : N$ and $N : CH_3 : CH_3 : NH_2 = 4:2:1$ and $6:4:2:1$]. This body is prepared by mixing in a beaker placed in a freezing mixture 121grms. metaxylidine with 157grms. metaxylidine hydrochloride, and adding gradually a 20 to 25 per cent. solution of 69grms. sodium nitrite. The diazo-amido compound thus formed is extracted with ether, and after evaporation of the latter, mixed with 120grms. metaxylidine and 10 to 15grms. metaxylidine hydrochloride. The mixture is heated in a water-bath to 50° until a sample heated with acid does not give off any more nitrogen. The hydrochloride of the amido-azo compound which remains behind on treating the mixture with moderately dilute boiling hydrochloric acid is, after washing with water, alcohol, and ether, decomposed by means of ammonia. The base is purified by recrystallisation from alcohol or benzene. The same process is adopted for the preparation of the other amido-azo-xylenes. Amido-azometaxylene crystallises in fine orange-yellow scales, melting at 78° . The hydrochloride is a bright-yellow powder, dissolving in alcohol and more readily in phenol, with a beautiful green colour. By the reduction with stannous chloride and hydrochloric acid a diamine is formed (besides metaxylidine), melting at 77° to 78° , and giving all the reactions of the ortho-diamines.

Amido-azometaxylene— $C_6H_3(CH_3)_2(CH_3)N = NC_6H_4(CH_3)(CH_3)NH_2$. [$CH_3 : CH_3 : N$ and $N : CH_3 : CH_3 : NH_2 = 6:2:1$ and $4:6:2:1$]. Yellow scales, readily soluble in strong alcohol and benzene; melting-point, 77.5° . The hydrochloride dissolves in alcohol and phenol, with a red colour. The diamine forms a quinone, which

fact, supported by the impossibility of obtaining (under the ordinary conditions) amido-azo compounds with the $N=N$ group in meta-position to the amide, and the red colour of the hydrochloride, seems to give proof for the correctness of the above formula.

Amido-azometaxylene— $C_6H_3(CH_3)_2N = NC_6H_4(CH_3)(CH_3)NH_2$. [N and $N : CH_3 : CH_3 : NH_2 = 1$ and $4:5:3:1$]. Crystallises from alcohol in yellow scales, melting at 95° . The solution of the hydrochloride in phenol possesses a violet-red colour. By reduction a para-diamine is formed.

Amido-azo-orthoxylylene— $C_6H_3(CH_3)_2N = NC_6H_4(CH_3)_2NH_2$. [$CH_3 : CH_3 : N$ and $N : CH_3 : CH_3 : NH_2 = 3:2:1$ and $4:2:3:1$]. Yellow scales; melting-point 110.5° . From the diamine formed by reduction, orthoxylo-quinone, melting-point 55° was obtained. Hydrochloride soluble in phenol, with a red colour.

Amido-azo-orthoxylylene— $C_6H_3(CH_3)_2N = NC_6H_4(CH_3)_2NH_2$. [$CH_3 : CH_3 : N$ and $N : CH_3 : CH_3 : NH_2 = 4:3:1$ and $6:4:3:1$]. Yellow scales (from alcohol); melting-point 179° . The hydrochloride dissolves in phenol, with a green colour. The diamine gave the characteristic reactions of the compounds of the ortho-series.

Amido-azo-paraxylylene— $C_6H_3(CH_3)_2N = NC_6H_4(CH_3)_2NH_2$. [$CH_3 : CH_3 : N$ and $N : CH_3 : CH_3 : NH_2 = 5:2:1$ and $4:5:2:1$]. Crystallises from alcohol in red scales, melting at 150° . The hydrochloride is red, and dissolves in phenol with a violet-red colour. The diamine crystallises from benzene in beautiful white needles, melting at 146.5° to 147° . It shows all the reactions of the para-diamines, and, by oxidation, yields paraxylo-quinone; melting-point 123° .

None of the above-described amido-azo-xylenes are identical with that obtained by Nietzki. As the diamine and the quinone from amido-azo-paraxylylene agree in all their properties with Nietzki's corresponding compounds, and as the latter were obtained from commercial xylidine, containing meta- and paraxylylene, it appeared very probable that Nietzki's product was a mixed azo-derivative of meta- and paraxylylene. A mixed amido-azo-ameta-paraxylylene— $C_6H_3(CH_3)_2N = NC_6H_4(CH_3)_2NH_2$. [$CH_3 : CH_3 : N$ and $N : CH_3 : CH_3 : NH_2 = 4:2:1$ and $4:5:2:1$ —identical with Nietzki's compound, was prepared by adding to a mixture of 26grms. metaxylidine hydrochloride, and 20grms. paraxylylene, 50cc. of a solution of sodium-nitrite containing 227grms. $NaNO_2$ in 1 litre. A diazo-amido compound, melting at 47° , was formed, which, on keeping, spontaneously changed into the amido-azo compound. This transformation can be completed in a few minutes by heating on the water-bath with 20grms. paraxylylene and 4grms. paraxylylene hydrochloride. This amido-azo-xylene crystallises from alcohol in red scales, melting at 110° to 111° . By reduction it yields meta-xylidine and xylene-paradiazine, melting at 146.5° to 147° , and forming paraxyloquinone.—F. M.

On the Constitution of the Phthalic Acids. E. Nölting. Ber. 18, 2687.

THE author has found that the oxidation of the three xylenes takes place very smoothly when permanganate is employed, and that excellent yields of the three phthalic acids are obtained. As metaxylene forms three isomeric nitro-xylenes, xylidines, and xylenols, orthoxylylene two, and paraxylylene only one of each of these derivatives, isophthalic acid has the position 1, 3; phthalic acid, 1, 2; and terephthalic acid, 1, 4.—F. M.

New Method for the Preparation of Azo-bodies. O. N. Witt. Ber. 18, 2912–2913.

CONSIDERING the unsatisfactory character of the present methods of preparing azo-bodies, the author recommends the following method, which he has found extremely convenient, and of almost universal application. The process depends upon the reduction of the nitro-compound with a solution of sodium-stannite, which is prepared by pouring the calculated quantity of stannous chloride into a cold solution of $NaOH$ in excess. The nitro-

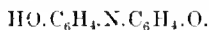
compound is simply heated on a water-bath with the solution, and agitated at intervals. If necessary, it may be previously dissolved in alcohol. Good results were obtained with azo-benzene, *o*- and *p*-azo-toluene, azo-benzenedi-sulphonic acid, and azo-*p*-toluene-di-sulphonic acid; but azo-naphthalene could not be prepared in this way.—A. G. G.

On Indophenols and Indoanilines. R. Möhlau.
Ber. 18, 2913—2918.

THE investigations of Bindschedler, Caro, Nietzki and Witt have shown that the oxidation of mixtures of para-diamines or para-indophenols, on the one hand, with amines or phenols, on the other, gives rise to a great number of colouring matters, some of which belong to the safranin series, others to the indophenol and indoaniline group, and others, again, are unstable intermediate products, which under suitable conditions are capable of being converted into members of one or the other group. That the indophenols and indoanilines are analogously constituted has been long assumed, and the author now brings additional evidence to support this assumption by the conversion of dimethylphenylene green, $(\text{CH}_3)_2\text{N} \cdot \text{C}_6\text{H}_4 \cdot \text{N} : \text{C}_6\text{H}_4 \cdot \text{N}(\text{CH}_3)_2$, into phenol-blue, $(\text{CH}_3)_2\text{N} \cdot \text{C}_6\text{H}_4 \cdot \text{N} : \text{C}_6\text{H}_4 \cdot \text{O}$. This change is produced

by the action of a cold dilute solution of NaOH, dimethylaniline being split off, and the yield of phenol-blue is about 70 per cent. of the theoretical quantity.

By the action of a boiling solution of NaOH on dimethylphenylene-green or phenol-blue the reaction goes further, splitting off a second molecule of dimethylaniline and forming quinonephenolide,



The corresponding naphthylamine compound which should be produced by oxidation of a mixture of dimethyl-*p*-phenylene-diamine and α -naphthylamine is still more unstable, for the chief product of this reaction is α -naphthol-blue, $(\text{CH}_3)_2\text{N} \cdot \text{C}_6\text{H}_4 \cdot \text{N} : \text{C}_{10}\text{H}_7\text{O}$, the naphthylamine compound first formed being decomposed during the reaction, with evolution of NH_3 .

Phenol-blue crystallises from water in steel-blue glistening prisms; from alcohol it forms large bronzy crystals. By cold aqueous acids it is taken up with a blue colour, but on warming, the solution is at once resolved into quinone and dimethyl-*p*-phenylenediamine. The α -naphthol-blue is insoluble in water, but crystallises from alcohol in bluish-violet bronzy crystals. It dissolves in cold acids with a yellow colour, and on allowing the solution to stand it is split up into α -naphthoquinone and dimethyl-*p*-phenylenediamine.—A. G. G.

Commercial Xylidines. W. Staedel and O. Hölz. Ber. 18, 2919—2924.

THE authors have carefully studied the isomeric xylidines occurring in the commercial compound, and have confirmed results already published by Nöling, Witt and Forel (Ber. 18, 2664; this Journal, iv. 741—742), and Nietzki (Ber. 13, 470).

The two isomers, amido-*m*-xylene [$\text{CH}_3 : \text{CH}_3 : \text{NH}_2 = 1 : 3 : 4$] and amido-*p*-xylene were separated by fractional crystallisation of the hydro-bromides; the former crystallises in tables or prisms, the latter in needles. *m*-xylidine gives by the diazo-reaction *m*-xylene and *m*-xylenol. α -*m*-xylidine gives on oxidation by fusion with KOH, *m*-hydroxytoluic acid.

Although the *p*-xylidine could not be prepared in a state of purity (containing an admixture of the *m*-compound), the mixed bases give on oxidation considerable quantities of xyloquinone, indicating the presence of the *p*-compound. Xyloquinol gives with benzoyl chloride dibenzoyl xyloquinol and a corresponding diethyl compound.—J. B. C.

α -Naphthol- β -Sulphonic Acid. A. Claus and M. Knyrim.
Ber. 18, 2924—2930.

ON sulphonating α -naphthol by the usual method, two sulphonic acids are always formed; and these may be separated by the different solubilities of their lead or barium salts. It appears also that a third α -naphtholsulphonic acid is formed and remains dissolved with the α -sulphonic acid, as lime or lead salt. This acid is being investigated by Linke. The barium salt which first crystallises out is the salt of α -naphthol- β -sulphonic acid. The acid is very unstable, and readily decomposes with separation of α -naphthol. To arrive at the constitution of this acid, the authors tried the action of PCl_5 . Instead of the sulphonic chloride, dichloronaphthol and also trichloronaphthol were formed. By the further action of PCl_5 on dichloronaphthol, trichloronaphthalene is produced. On oxidation it is decomposed completely into phthalic acid. For this reason and from its method of formation it is considered to be 1 : 2 : 3 trichloronaphthalene.

By treating dichloronaphthol with chromic and acetic acids, a portion is oxidised to dichloronaphthoquinone, the remainder being either unchanged or oxidised to phthalic acid. As this body is undoubtedly an α -compound, it follows that the sulphonic acid above referred to has the group SO_3H in the β position on the same side of the naphthalene ring as the hydroxyl group of α -naphthol.—J. B. C.

Azo-compounds formed by the Action of Diazo-phenols on β -Naphthylamine. O. Sachs. Ber. 18, 3125—3132.

THE author has prepared the following compounds in order further to investigate the doubtful constitution of the azo- β -derivatives of naphthalene. His results quite agree with those obtained by Lawson (Ber. 18, 796 and 2422; this Journal, iv. 395, and v. 26)—namely, that these bodies behave like diazoamido-compounds with regard to their decomposition by acids into β -naphthylamine, the corresponding phenol and nitrogen; but react on reduction like amido azo-derivatives, giving 1 : 2 naphthylenediamine and the amine.

*Compound from *o*-diazophenol and β -naphthylamine,* $\text{C}_6\text{H}_4(\text{OH}) \cdot \text{N}_3 \cdot \text{C}_{10}\text{H}_7$.—Crystallises from alcohol or acetic acid in fine red needles, from benzene in dark red plates. It melts at 192° — 193° . It dissolves in aqueous or alcoholic NaOH, but is insoluble in water. It gives a mono-acetyl derivative melting at 198° and a mono-benzoyl derivative, melting at 183° . By heating it with HCl at 150° it is split up into β -naphthylamine, pyrocatechol and nitrogen.

Bromine in cold acetic acid solution forms di-bromo- β -naphthylamine and a bromopyrocatechol (?), with evolution of nitrogen. On reduction with acetic acid and zinc dust it gives 1 : 2 naphthylenediamine.

*Compound from *o*-diazophenol and β -naphthylamine,* $\text{C}_6\text{H}_4(\text{OH}) \cdot \text{N}_3 \cdot \text{C}_{10}\text{H}_7$.—Forms flat red prisms of melting-point 191° — 193° , insoluble in water, but easily soluble in benzene and acetic acid. Its mono-acetyl derivative melts at 218° , and its mono-benzoyl derivative at 244° .

By heating with HCl it is resolved into β -naphthylamine, quinol and nitrogen. Bromine gives di-bromo- β -naphthylamine, a brominated quinol and nitrogen; whilst on reduction it yields 1 : 2 naphthylenediamine.

*Compound from *o*-diazophenolmethyl-ether and β -naphthylamine,* $\text{C}_6\text{H}_4(\text{OMe}) \cdot \text{N}_3 \cdot \text{C}_{10}\text{H}_7$.—Crystallises in dark red monoclinic prisms, which melt at 133° and are insoluble in water.

It reacts towards acids, bromine, and reducing agents like the preceding compounds. Its acetyl derivative melts at 199° and its benzoyl derivative at 153° .

—A. G. G.

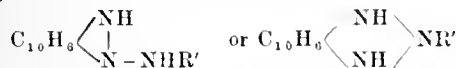
Constitution of the Azo-compounds of β -Naphthylamine. Th. Zincke. Ber. 18, 3132—3141.

THE author discusses the constitution of the azo-derivatives formed by combining diazo-compounds with β -naphthylamine. Three hypotheses are possible:—(1) That these bodies are true diazo-amido compounds; (2) that they are α -amido-azo derivatives; (3) that they are hydrazimido compounds.

The first hypothesis easily explains their decomposition by acids; and their reduction to naphthylendiamine may be accounted for by assuming that a change into the amido-azo compound takes place during the reduction. However, the fact that different but isomeric bodies are formed by diazotising the β -naphthylamine and combining it with the other amine militates against this hypothesis, for in the formation of diazo-amido compounds it is immaterial which amine is diazotised first.

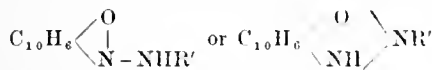
The second hypothesis: That the compounds are *o*-amido-azo derivatives does not agree with the fact that these bodies are not diazotisable, nor with their behaviour on oxidation, both of which conditions tend to show that they do not contain an NH_2 group.

The third hypothesis, which appears to the author the most likely, involves equal probability for two formulae—viz. :—



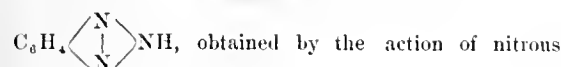
of which the latter was proposed by Meldola (*J. Chem. Soc.*, 1884, 107).

These formulae express the analogy of the β -naphthylamine compounds to the corresponding β -naphthol compounds, which latter must have the constitution:



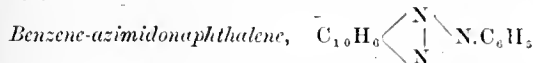
Since they are also formed by the action of phenylhydrazine on β -naphthoquinone.

The third hypothesis is also strongly supported by the fact that on oxidation they give rise to white crystalline azimido compounds, which probably have the constitution:



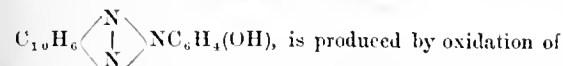
acid on *o*-phenylenediamine.

The formation of the hydrazimido compounds from a diazo salt and β -naphthylamine can be explained by assuming the intermediate formation of true diazo-amido compounds, $\text{C}_{10}\text{H}_7 - \text{NH} - \text{N} = \text{NR}'$, which by taking up H_2O would form $\text{C}_{10}\text{H}_7 - \text{NH} - \text{N}(\text{OH}) - \text{NHR}'$ or $\text{C}_{10}\text{H}_7 - \text{NH} - \text{NH} - \text{N}(\text{OH})\text{R}'$, and on again eliminating it might give the hydrazimido compound. The decomposition by acids might also be explained as a change inverse to the above, resulting in the formation of the diazo-amido compound, which would then be decomposed.



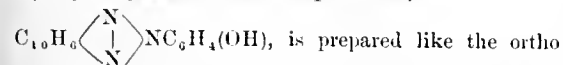
is prepared by oxidising benzene-azo- β -naphthylamine with CrO_3 in acetic acid. It forms fine white needles, melting at $107-108^\circ$, and sparingly soluble in alcohol and benzene. It is very stable towards reducing agents.

o-Hydroxybenzene-azimidonaphthalene,



an alkaline solution of hydroxy-benzene-azo- β -naphthylamine with lead peroxide. It crystallises from alcohol in white silky needles, which melt at 140° .

p-Hydroxybenzene-azimidonaphthalene,

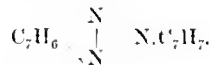


compound, and forms white needles or thick crystals, of melting-point 199° , sparingly soluble in benzene. Its acetyl derivative forms thin silky plates melting at 165° .

—A. G. G.

On Orthamido-azo Compounds. Th. Zincke. Ber. 18, 3142—3144.

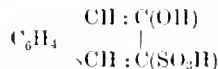
STARTING from the conclusions arrived at in the preceding paper, it seemed probable that the so-called orthamido-azo compounds of the benzene series might be constituted analogously to the β -naphthylamine compounds, and would also prove to be hydrazimido compounds, and not amido-azo compounds. To test this assumption, the author has exposed *o*-amido-azotoluene to oxidation with CrO_3 in acetic acid; and finds that, like the naphthylamine derivatives, it gives a colourless crystalline substance which probably has the constitution—



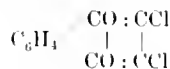
This azimido compound crystallises in thin plates, which melt at 126° , and is easily soluble in hot alcohol and benzene.—A. G. G.

On the α -Sulphonic Acid of β -Naphthol. Ad. Clans and O. Volz. Ber. 18, 3154—3162.

THIS sulphonic acid, which is formed at a lower temperature than the β -acid, and is usually known as Rumpf's acid, must have the constitution—



since by treatment with PCl_5 the authors obtained from it a mixture of 2:3 chloronaphthol and 2:3 dichloronaphthalene (5 of Clève). This dichloronaphthalene forms small glistening plates, which melt at 61.5° uncorr., and boil at 286° uncorr. On oxidation with CrO_3 , it gives dichloro- α -naphthoquinone—



the anilide of which forms red crystals melting at 202° . The 2:3 chloronaphthol sublimes in fine colourless needles of melting-point 101° uncorr., and boiling-point $307-308^\circ$; is sparingly soluble in water. Rumpf's acid readily forms basic salts; thus the ordinary sodium salt soluble in spirit is $\text{C}_{10}\text{H}_6(\text{ONa})\text{SO}_3\text{Na}$. It crystallises in hygroscopic needles, very soluble in water. This tendency to form basic compounds is probably due to the proximity of the OH and HSO_3 groups. The neutral sodium salt, $\text{C}_{10}\text{H}_6(\text{OH})\text{SO}_3\text{Na}$, forms six-sided plates, sparingly soluble in alcohol, easily soluble in water. The neutral zinc salt, $(\text{C}_{10}\text{H}_7\text{O.SO}_3)_2\text{Zn} + 2\text{H}_2\text{O}$, crystallises from concentrated aqueous solution in needles. The neutral lead salt, $(\text{C}_{10}\text{H}_7\text{O.SO}_3)_2\text{Pb} + 2\frac{1}{2}\text{H}_2\text{O}$, forms colourless glistening rhombohedra, easily soluble in water.

—A. G. G.

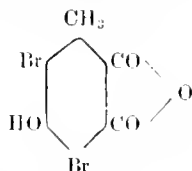
On the Constitution of Cochineal. W. Will and H. Leymann. Ber. 18, 3180—3193.

IT has been shown by Hasiwetz and Grabowski that carminic acid is the glucoside of a substance, $\text{C}_{11}\text{H}_{12}\text{O}_5$, which was named carmine-red. The authors have examined the action of bromine upon this body. If carmine-red be dissolved in acetic acid, and treated with bromine, two products are obtained, named provisionally α - and β -bromocarmine. The α -bromocarmine is sparingly soluble in acetic acid, and separates in crystals (yield 10 per cent.), whilst the amorphous β -bromocarmine remains in solution, and is precipitated on adding water (yield 20 per cent.).

α -Bromocarmine, $\text{C}_{10}\text{H}_4\text{Br}_2\text{O}_5$, crystallises in colourless needles, which melt at 248° , and is easily soluble in alkalis.

If it is boiled with strong aqueous KOH it yields α -di-hydroxybromocarmine, $\text{C}_{10}\text{H}_6\text{Br}_2\text{O}_5$. This body forms colourless crystals, melting at 208° . By its behaviour on etherification, it is shown to contain one CO_2H and one phenolic OH group. On oxidation with alkaline KMnO_4 ,

it yields two bodies—an acid and a neutral substance. (a) The acid, $C_9H_6Br_2O_4$, forms colourless crystals of melting-point 244° . By its reactions on methylation, it is proved to contain one OH and one CO_2H , and hence probably has the constitution $C_6(CH_3)(OH)Br_2(CO_2H)(CO_2H)$ or $C_6H(CH_3)(OH)Br_2 \cdot CO_2CO_2H$. (b) The neutral body, $C_9H_4Br_2O_4$, melts at 195° ; and, by its reactions, is shown to be a *dibromohydroxymethylphthalic anhydride*, probably possessing the constitution—



On methylating, it yields the trimethylether of a dibromo-oxyethylphthalic acid. This ether melts at 70° , and on boiling with alcoholic KOH gives the dibromomethoxymethylphthalic acid of melting-point 100° , whose anhydride melts at 144° .

β -Bromocarmine, the second product of the bromination of carmine-red, separates in yellow amorphous flocks on diluting the acetic acid solution with water. It is easily soluble in alcohol, acetic acid, etc., but could not be obtained in a pure state. By boiling with strong KOH it yields β -hydroxybromocarmine, $C_{11}H_8Br_2O_4$. This acid crystallises in glistening yellow needles, which melt at 232° . It is dibasic, and forms red coloured salts. On oxidation with alkaline $KMnO_4$ it yields—

(a) A neutral body, $C_{10}H_6Br_2O_4$, identical with the dibromohydroxymethylphthalic anhydride obtained by oxidation of the α -hydroxybromocarmine, and (b) an acid, $C_{10}H_4Br_2O_6$, which probably has the constitution of a *dibromohydroxycarboxybenzoylformic acid* $C_6(CH_3)Br_2(OH)(CO_2H) \cdot CO_2CO_2H$. This acid crystallises from water in colourless prisms ($+H_2O$), which melt at 230° with evolution of CO_2 .—A. G. G.

Detection of Alkanet Dye. J. Herz. Rep. Anal. Chem. 5, 210—211.

WINES coloured with alkanet tincture yield to ether a yellow colouring matter, while the alkanet red is easily removed by amylie alcohol. In order to separate the alkanet dye from other colouring matters, some almond or olive oil is added, and the amylie alcohol is removed by evaporation on the water-bath. The oil-drops are washed in water, and are seen to be coloured a fine red if alkanet be present. This colour is changed to blue when caustic soda is added in excess, but the blue colour vanishes on the addition of acids. Wines which have been coloured with old alkanet tincture impart to the oil a reddish-violet tint, and the alkaline solution is not blue, but green.—E. G. C.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Improvements in the Manufacture or Preparation of Mordants or Fixers for use in Connection with Marking Ink, Pencils, or Points. James Hickisson, London. Eng. Pat. 15,961, December 4, 1884.

THE object of this invention is to manufacture mordants or fixers for use in connection with marking ink, points, or pencils in the form of lozenges, pills, tablets, pastes or powders, or in strip form, the ingredients among which are pyrogallie acid, borax, hyposulphite, soda-carbonate, ammonia, alum, washing soda, or other salts; also gums, French chalk, wax, albumen, collodin, varnish, etc.—T.

Improvements in Writing Ink. Lawrence Hill Armour. Gateshead-on-Tyne. Eng. Pat. 440, January 13, 1885.

THIS invention is to produce an ink which can be washed off paper, or fixed at will. For the former, the inventor uses insoluble pigments suspended in mucilaginous solu-

tions, with the addition of salt, or ammonium chloride, to increase the specific gravity. For the latter, he uses gelatine and chrome alum, or potash bichromate, in the mixture—which is used in non-actinic light—so that while it may be washed off before exposure to actinic light, it may become fixed after exposure adequate to rendering the gelatine insoluble.—T.

Improvements in the Means or Apparatus employed for Dyeing Woolen, Silk, and other Woven or Felted Fabrics and Yarns. Joseph Kettitt. Eng. Pat. 6296, May 22, 1885.

THIS invention differs from the former in that the fabric, after passing through the trough containing the colouring matter, is made to pass over a number of rollers contained in a box into which steam is passed.—E. J. B.

VII.—ACIDS, ALKALIS, AND SALTS.

Action of Hydrochloric Acid on Antimony Sulphide. By J. Lang. Ber. 18, 2714.

THE author finds that antimony sulphide is decomposed by hydrochloric acid of all concentrations, however weak, and at higher temperatures even by pure water, the final state of equilibrium depending on the concentration of the hydrochloric acid, the temperature, and the partial pressure of the resulting sulphuretted hydrogen on the liquid. Antimony chloride dissolved in water acidified with hydrochloric acid, is decomposed by sulphuretted hydrogen, the amount of decomposition depending on the amount of free acid, the temperature, and the pressure of the sulphuretted hydrogen on the liquid. For instance, if a solution of antimony chloride in hydrochloric acid be treated with sulphuretted hydrogen at the ordinary pressure, till no further precipitation occurs, and the clear liquid containing the undecomposed antimony chloride be then decanted and treated with sulphuretted hydrogen at increased pressure, a further precipitation of sulphide will take place.—F. L. T.

On the Composition of "Vitriol Stone" and Colcothar. F. Stolba. Ber. Königl. Böhm. Gesells. 1885.

VITRIOL stone is the important material from which the so-called fuming or Bohemian sulphuric acid is manufactured, and it is obtained from the rock known as vitriol slate ("vitriolschiefer") in the following manner. Large masses of pyritous slate (which belongs to the Silurian formation, and consists of a quartzose matrix containing pyrites, carbon and clay) are exposed to the weathering action of the atmosphere for three years. The products of oxidation so formed are ferrous sulphate and sulphuric acid, which latter acts energetically upon the clay; and, finally, aluminium sulphate and other sulphates are yielded. The ferrous sulphate at first formed becomes, by oxidation ferric sulphate, which, together with the aluminium sulphate, is the principal product of the weathering of the vitriol slate. Ferrous sulphate remains only in small quantities. The next operation is lixiviation of the mass with water, after which the liquor obtained is concentrated to a density of $40^\circ B.$, and finally evaporated in pans until, on cooling, a crystalline cake of vitriol stone is obtained. The vitriol stone is now calcined, in order to remove the greater part of its water. The resulting product, when heated to a very high temperature in clay retorts, yields sulphuric anhydride; and a residue, termed colcothar, remains in the retorts. The composition of vitriol stone and colcothar will be seen from the following analyses:—

Vitriol stone.— Fe_2O_3 —20.07, Al_2O_3 —4.67, FeO —0.64, MnO —traces, CaO —0.14, MgO —0.39, K_2O —0.07, Na_2O —0.05, CuO —0.10, SiO_2 —0.10, P_2O_5 —traces, SO_3 —40.51, As —traces, H_2O —32.58—99.32.
Vitriol stone.— $Fe_2(SO_4)_3$ —50.17, $Al_2(SO_4)_3$ —11.94, $FeSO_4$ —1.35, $MgSO_4$ —1.17, $CaSO_4$ —0.33, $CuSO_4$ —0.20, K_2SO_4 —0.13, Na_2SO_4 —0.11, H_2SO_4 —1.49, MnO , As , and P_2O_5 —traces, SiO_2 —9.10, OH_2 —32.31—99.29.

Colcothar.— Fe_2O_3 —74·62, Al_2O_3 —12·53, MgO —3·23, CaO —0·82, SO_3 —5·17, SiO_2 —1·17, CuO —0·20, H_2O —1·30—99·04.—E. G. C.

Improvements in the Treatment of Certain Residual Liquors from Copper Works and Chlorine Manufacture, to obtain Sulphate of Lime and Oxide of Iron. G. L. Wigg, M. Steele and W. J. Wigg, Runcorn. Eng. Pat. 13,722, October 17, 1884.

THE residual liquor obtained in the precipitation of copper by the wet process, and the residual chloride of calcium from the Weldon process, are mixed in equivalent proportions, when a white bulky precipitate of sulphate of lime is formed. The mass is filter-pressed and washed, and thus forms "Pearl-hardening" in fit condition for use by paper-makers; or, it is furnace-dried at a gentle heat so as to form plaster of paris. The clear filtrate from the precipitate is treated with milk of lime in order to precipitate the iron as ferrous hydrate. The dark green precipitate, which readily forms, is further oxidised by injection of air or chlorine, washed in the filter-press and furnace-dried so as to yield the various shades required.

—S. H.

Improvements in Purifying and Decolourising Crude Nitric Acid, and in Apparatus therefor. J. W. Pratt, Runcorn. Eng. Pat. 14,173, October 27, 1884.

GLASS or earthenware cylinders are arranged in series, and connected by pipes so bent that a current of gas sent through the series will ascend from the bottom of each vessel to the top. The inlet pipe connected to the first vessel is coupled to a horizontal metallic chamber capable of being heated, and this cylinder in its turn is joined to a small coke-tower, which can be moistened with strong vitriol. From the exit of the series a pipe leads to another coke-tower. Between each two vessels is a small chamber into which the current of gas may be switched by means of taps. To bring this apparatus into operation, a quantity of crude nitric acid is placed in each cylinder of the series, and a current of air drawn or forced through the acid. The temperature of the acid must not be below 60° F., or otherwise the air must first be sucked through the warming chamber. The small coke-tower serves to take up the moisture in the air-current. The air in its passage through the acid oxidises, and also carries off mechanically the lower oxides of nitrogen. As the latter portion of nitrogen oxides, carried off from one vessel, would be liable to reabsorption by the next, the current of air is diverted into the small chambers, which are filled with water or oil of vitriol to absorb the oxides of nitrogen carried over. The acid is caused to circulate from the exit to the leader end of the series by reversing the direction of the air-current, forcing or drawing the acid from one vessel to another. The cylinders are fitted with suitable openings for adding any precipitant, the current of air serving to distribute it thoroughly.

—S. H.

Improvements in the Manufacture of Caustic Soda and Potash and By-products therefrom. Sir Francis Bolton, London. Eng. Pat. 14,866, November 11, 1884.

THE invention consists in converting potassium or sodium chloride into caustic potash or soda without the use of sulphuric acid, while at the same time hydrochloric acid is obtained as a by-product. Salt and finely powdered sulphate of barium or strontium are mixed together and heated in a furnace in an atmosphere of steam. Hydrochloric acid is given off; and the resulting mass consists of "a mixture of sodium and barium (or strontium) with an equivalent of oxygen and an equivalent of SO_4 ", along with undecomposed salt and earthy sulphate. On lixiviation a solution of caustic soda is obtained containing more or less chloride of sodium, and a precipitate of sulphate of baryta (or strontia), which can be used over again. The solution of caustic soda is concentrated in the usual manner. The same process may be applied to potassium chloride for the manufacture of caustic potash.—S. H.

Improvements in or relating to the Manufacture of Bisulphite of Calcium, or of other Alkaline Earth. J. W. Kynaston, Liverpool. Eng. Pat. 15,182, Nov. 18, 1884.

SULPHUROUS acid obtained from any source is passed into the bottom of a tower, from the top of which milk of lime of 5 to 6° Tw. descends in a regular stream. The proportion of milk of lime running down the tower must be so regulated that the liquor issuing at the bottom contains a small proportion of sulphurous acid in excess. The mixture of the very insoluble neutral calcium sulphite and water is caught in a lead cistern, when the sulphite quickly settles down, and the supernatant liquor may be run away. The pasty mass is removed from the settler and divided into two equal parts. The one part is transferred to a stone or lead-lined iron vessel, and there mixed with so much water as to contain from $8\frac{1}{2}$ to 9 lb. of calcium sulphite per cubic foot. The other portion is transferred to a stoneware still, constructed similarly to a chlorine still. A pipe from the top of this still leads to the bottom of the first vessel, where it terminates into a distributor. The openings being securely adjusted, hydrochloric acid is run into the still in sufficient quantity to completely decompose the calcium sulphite, and the sulphurous acid is finally driven off by blowing steam into the mixture. The pure sulphurous acid liberated is easily absorbed by the watery mixture of calcium sulphite, and there is obtained a solution of bisulphite of calcium completely saturated and of about 25° Tw.—S. H.

Improvements in or connected with the Manufacture of Sulphite of Calcium. J. W. Kynaston, Liverpool. Eng. Pat. 15,659, November 28, 1884.

A MIXTURE of calcium chloride solution and magnesia, containing also some carbonate of lime, obtained as a residue of an operation hereinafter described, is brought in contact with sulphurous acid, when the following reaction takes place:— $\text{CaCl}_2 + \text{MgO} + \text{SO}_2 = \text{CaSO}_3 + \text{MgCl}_2$. The calcium carbonate present is also completely converted into sulphite, carbon dioxide being liberated. In practice, the sulphurous acid is made to ascend a flag-stone tower, packed with pigeon-holed brick-work, while the mixture of calcium chloride solution, magnesia, and calcium carbonate is run down the tower in such proportion, that from the bottom there runs a mixture of neutral sulphite of calcium, suspended in a solution of magnesium chloride, and containing a slight excess of free sulphurous acid. This mixture is allowed to flow into settling tanks, and when the sulphite of calcium has settled down, the supernatant liquor of magnesium chloride is drawn off and concentrated to a density of from 40 to 45° Tw. A quantity of alkali waste is now taken, and to it, in a closed iron vessel, is added the solution of magnesium chloride. On heating, a decomposition takes place, sulphuretted hydrogen being given off, whilst there remains in the still a mixture of chloride of calcium, magnesia, and carbonate of lime, along with cinders and other matter contained in the original alkali waste. This mixture is passed through a strainer, which retains the cinders and grosser matter, and is then ready to be subjected to the treatment with sulphurous acid, as mentioned above.—S. H.

Improvements in the Manufacture of Acetic Acid, and in Apparatus therefor. E. C. Allan and F. M. Allan, Glasgow. Eng. Pat. 16,636, December 18, 1884.

A CYLINDER A, with a steam-jacket B, is provided with a central shaft D, carrying agitating blades *d*, passing through stuffing boxes in covers C, and driven by gearing E. An acetate, such as acetate of lime, and a mineral acid are introduced through door F in dome E'. Steam is admitted into the jacket B; the acetic vapour formed leaves the apparatus by G, entering the purifier H, where it is washed by any suitable liquids, such as water or acetic acid, containing the carbonates, acetates, oxides of sodium, potassium, magnesium or lead, or heavy petroleum oils, as a solvent for the tar. The purified vapour is condensed in J. The spent material is pushed along

the apparatus by skew blades *d*, and through a discharging door in the opposite end *G*. Steam may be injected

FIG. 2.

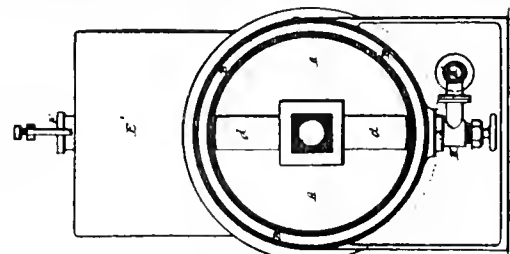
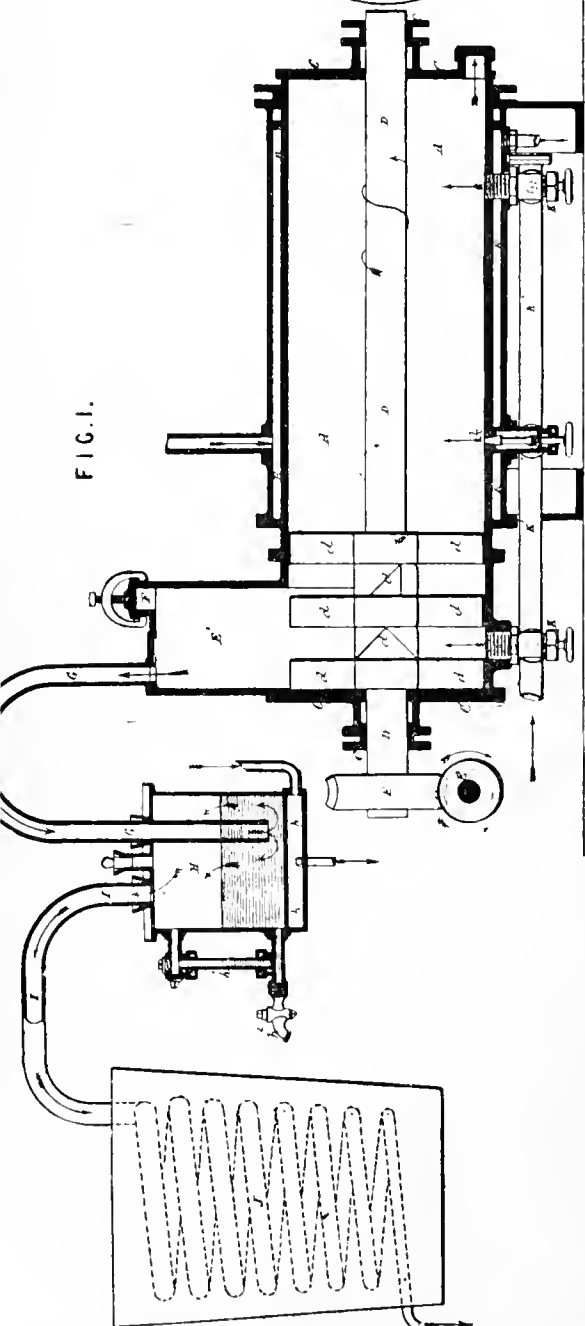


FIG. 1.



through valves *k* for further exhausting the material. Various modifications and matters of detail are illustrated in the specification.—C. C. H.

Improvements in the Treatment of Vat-liquor for the Elimination of Sulphides and other Impurities, and in the Recovery and Re-use of the Reagents employed therein. T. D. Owen, Egremont, Cheshire. Eng. Pat. 259, January 8, 1885.

SETTLED vat-liquor of 1·3 sp. gr., is heated nearly to its boiling-point. Oxide of lead, or oxide of lead dissolved in an alkaline solution, is then added in sufficient quantity to decompose the sulphides contained in the solution. The sulphide of lead formed settles very quickly, carrying down the whole of the iron held in solution. The purified liquor is allowed to crystallise, yielding soda crystals containing only from 0·2 to 0·4 per cent. of hydrate. The mother-liquor serves for the manufacture of caustic soda. The sulphide of lead formed in the purification of vat-liquor is roasted at a low red-heat in order to convert it into oxide. After washing with water to free it from alkaline salts, it is ready for re-use. Any loss of lead is made up by the use of sulphate of lead from the vitriol chambers. When contaminated with iron and other impurities by repeated use, the lead compound is treated with strong sulphuric or hydrochloric acid, so as to dissolve out the said impurities.

—S. H.

Improvements in the Treatment of Spent Oxides of Iron and other Substances containing Sulphur, such as Impure Sulphur Precipitate and Impure Melted Sulphur, to obtain Sulphur, and Arsenical Compounds, when the latter are present. J. Robinson, Widnes. Eng. Pat. 497, January 14, 1885.

IN carrying out this invention a different method must be employed, according as the material acted upon contains—1st, sulphur and other substances, but is free from arsenical compounds; or 2nd, sulphur and arsenical compounds; or 3rd, sulphur in combination with other substances, or even sulphur compounds mixed with free sulphur. In the first case, the material to be treated is mixed with soda-waste and lixiviated with a yellow liquor identical in composition with the "yellow liquors" of Mond's sulphur-recovery process. The lixiviation may be assisted by agitation, heat, or pressure, until the liquor has taken up as much sulphur as possible. The solution is then run off and mixed with "over-blown sulphur-liquor," containing a large proportion of sulphites and hyposulphites. It is then decomposed with hydrochloric or any convenient acid; or the solution as run off may be partially oxidised until it has the right composition, so that, on the addition of hydrochloric acid, it will not give off gaseous sulphur compounds. In treating materials consisting of sulphur and arsenical compounds, they are at first lixiviated with only a small portion of the "yellow liquor," for the purpose of extracting the whole or a considerable portion of the arsenic sulphide. If necessary, the same treatment must be repeated. After running off the liquor, the solid residue is melted in a manner usual in the melting of sulphur precipitate; but the solid residue thus freed from arsenical compounds may now also be treated in the manner previously described. Another method of proceeding is, not to eliminate the arsenic until the precipitation of the sulphur takes place. In this case, the sulphur is first dissolved by "yellow liquor," and when the precipitant is added, care is taken not to add a sufficient amount to cause the precipitation of the whole of the sulphur. The arsenic thus remains in solution, and may then be separately precipitated. Lastly, when the sulphur is to be extracted from such substances as spent oxide of iron and the like, the mass is subjected to the action of air and steam, and afterwards lixiviated with "yellow liquor." After dissolving out the sulphur, the oxides of iron may be used again in the purifiers.—S. H.

Improvements in the Production of Chlorine and Hydrochloric Acid from Solutions of Chloride of Calcium. T. Twynam, London. Eng. Pat. 731, Jan. 19, 1885.

TO the solution of calcium chloride previously freed from any dissolved iron by a preliminary precipitation with lime or chalk, a sufficient quantity of milk of lime

is added to form oxychloride of calcium. To cause the formation of the latter, the solution must be heated to at least 50°C ., and the lime constantly agitated in the solution. After some hours the undissolved lime is allowed to settle, together with any sodium chloride which may have crystallised out; the solution being kept hot all the time. The clear liquor is run off and allowed to cool, when oxychloride crystals will readily form. They are separated from the mother-liquor, and dried at a gentle heat, in order to drive off the water of crystallisation. The resulting dry powder consists of an intimate mixture of chloride of calcium and lime. On strongly heating it in a current of air, hydrochloric acid and chlorine are given off, which may be utilised by well-known methods. When superheated steam and air are made to act on the mass, only hydrochloric acid is given off, but the decomposition is more complete. The lime remaining after the decomposition of the chloride may be used for the production of fresh calcium oxychloride.—S. H.

An Improved Method or Process of Purifying Hydrate of Strontium. E. F. Trachsel, London. Eng. Pat. 757, January 19, 1885.

IMPURE hydrate of strontium crystals, containing about 37 per cent. of anhydrous oxide, are dried in a muffle furnace, in order to increase the proportion of anhydrous oxide to about 60 to 70 per cent. By this treatment the sulphide of iron contained in the crystals will be oxidised, and the sulphide of strontium will be changed into hyposulphite, whilst about 2 per cent. of strontium hydrate will be changed into carbonate. The dried crystals are then dissolved in hot water, so that the strontium carbonate precipitates the iron, and the hyposulphite of strontium, which is colourless, remains in the mother-liquor.—S. H.

Improvements in the Manufacture of Sodium Bichromate. W. H. Higgin, Bolton. Eng. Pat. 1723, February 7, 1885.

THE aqueous solution of sodium monochromate obtained from the lixiviating tanks is mixed with the "acid washings" (the production of which is afterwards described), and evaporated to dryness. The residue consists mainly of sodium monochromate, but it also contains more or less sodium bichromate and other sodium salts, according to the composition of the "acid washings." This mass is treated, when cold, with a mineral acid of a certain strength, and in such quantity as to convert the whole of the monochromate present into bichromate. If hydrochloric acid be used, the following equation expresses the reaction:— $2\text{Na}_2\text{CrO}_4 + 2\text{HCl} = \text{Na}_2\text{Cr}_2\text{O}_7 + 2\text{NaCl} + \text{H}_2\text{O}$. Now, if the acid used be of the correct strength, the whole of the sodium bichromate is dissolved, whereas nearly the whole of the sodium chloride is left behind as a finely crystallised powder. The mass is filtered and the filtrate worked up for sodium bichromate in the usual manner. The residue consists of sodium chloride and some chromate salt adhering to it. It is washed with acid of the same kind as is used previously, and the "acid washings" thus formed are employed in the manner mentioned above.—S. H.

Improvements in the Manufacture of Magnesium Chloride. E. K. Muspratt and G. Eschellmann, Widnes. Eng. Pat. 1900, February 11, 1885.

IN a previous specification (No. 5168, 1883) the inventors described the treatment of the chlorate of potash mother-liquors for the manufacture of magnesium chloride. Owing to the presence of a small quantity of magnesium chlorate or hypochlorite, the magnesium chloride solution in boiling is found to dissolve a small quantity of iron from the pan, which colours the magnesium chloride red by formation of iron peroxide. This objectionable colouring of the magnesium chloride may be obviated by adding a sufficient quantity of caustic magnesia, caustic lime, or caustic soda; or by adding a suitable reducing agent such as sulphurous acid, arsenic trioxide, sodium hyposulphite; or lastly, by converting the magnesium

chlorate or hypochlorite into potassium or sodium chlorate or hypochlorite, neither of which will act in small quantities upon the iron of the boiling-down pans. It is also preferable to use cast-iron pans for the purpose of concentrating the liquors.—S. H.

Improvements in obtaining Ammonium Chloride and Cyanogen Compounds. A. French, Bearsden, Dumbartonshire. Eng. Pat. 5945, May 14, 1885.

ANY material containing carbon, nitrogen, sulphur, and common salt or another suitable chloride, is heated in a kiln, air and steam being injected during the heating process. The kiln is worked continuously. The reaction said to take place is expressed by the following equation:— $2\text{NaCl} + \text{H}_2\text{SO}_4 + 3\text{H}_2\text{O} + 2\text{N} + \text{C} = 2\text{NH}_4\text{Cl} + \text{Na}_2\text{SO}_4 + \text{CO}_2$. Nearly the whole of the nitrogen is said to be obtained as ammonium chloride, a small portion of it combining "with carbon and chlorine, hydrogen, carbon monoxide, or sulphurous anhydride to form various cyanogen compounds."—S. H.

Improvements in obtaining Carbonate of Potash by the Leblanc Process. H. Preetz, Stassfurt, Germany. Eng. Pat. 6644, June 1, 1885.

IF sulphate of potash, limestone, and coal are fused together for the manufacture of potassium carbonate, the mixture has to be heated to a very high temperature, which entails considerable losses, owing to a partial volatilisation of the potassium carbonate. The inventor has found that the formation of potassium carbonate takes place at a dull red heat without smelting of the mixture, if one molecule of magnesia be added for each molecule of potassium sulphate in the mixing. The addition of magnesia may be made either in the shape of magnesia, magnesium carbonate, or magnesium sulphate.—S. H.

Improvements in obtaining Sulphuretted Hydrogen from Sulphide of Ammonium. E. W. Parnell and J. Simpson, Liverpool. Eng. Pat. 8440, July 13, 1885.

WHEN Leblanc alkali-waste is treated with ammonium chloride, decomposition takes place, calcium chloride and ammonium sulphide being formed. After separating the latter by distillation, it is treated with ammonium sesquicarbonate, when ammonium monocarbonate is formed in solution with evolution of sulphuretted hydrogen. The ammonium monocarbonate may be again converted into sesquicarbonate by passing carbon dioxide through it; and may be used repeatedly, or it may be passed into the absorbing plant of the ammonia process with sodium chloride and carbon dioxide in the usual manner.—S. H.

A New or Improved Process for obtaining Silicates of the Alkalis and Alkaline Earths from the corresponding Sulphates, together with Sulphurous Acid or Sulphur and Apparatus therefor. W. P. Thompson. From J. and F. Weeren, Berlin. Eng. Pat. 8838, July 22, 1885.

THIS specification, which is accompanied by three diagrams, is not suitable for abstraction.—S. H.

Improvements in the Separation of Sulphuretted Hydrogen from Nitrogen. E. W. Parnell and J. Simpson, Liverpool. Eng. Pat. 7657, August 21, 1885.

THE mixed gases are subjected to the action of a solution containing about 5 per cent. of ammonium monosulphide, whereby sulphuretted hydrogen is absorbed with formation of ammonium sulphhydrate. This latter is decomposed again into sulphuretted hydrogen and ammonium monosulphide by being raised to boiling point, or by being subjected to a partial vacuum. The absorption is carried on in a tower filled with loose stones, at a temperature not above 70°F . The escaping nitrogen is washed with an acid solution to recover

escaping traces of ammonia. The sulphuretted hydrogen, when liberated from the ammonium hydrosulphide, must also go through this process.—A. R. D.

Improvements in or relating to the Manufacture of certain Cyanogen Compounds. Jno. Young, Campsie, Stirling. Eng. Pat. 16,046, August 29, 1885.

THIS invention relates to an improved material for the construction of retorts for the manufacture of cyanogen compounds, by passing nitrogenous gases over carbonaceous matter mixed with an alkali at a high temperature. Material which is non-acid and non-metallic is recommended. Compressed coke or plumbago answers moderately well, but magnesian limestone is the best. The raw limestone is calcined, ground, mixed with tar, moulded, and reburnt, as if for bricks for use in the Gilchrist-Thomas dephosphorising process.

—A. R. D.

The Manufacture of Anhydrous Oxide of Barium. L. Q. Brin and A. Brin, Paris. Eng. Pat. 151, October 5, 1885.

BARIUM nitrate is dried, placed in open crucibles and heated gradually up to 1000 to 1500° C., till the contents of the crucibles become solid, and assume a spongy appearance. The crucibles are then closed and kept at a white heat for four hours. They are then removed to an air-tight chamber, and allowed to cool under a partial vacuum. The result is a very pure anhydrous oxide, peculiarly adapted for use in the process of separating oxygen from nitrogen, described in specification 157 of even date with this.

—A. R. D.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Improvements in the Manufacture of Tiles and other Objects in Imitation of Majolica Ware. Johann Gottfried Müller, Schöneberg, Berlin. Eng. Pat. 1448, February 2, 1885.

THE inventor imitates majolica by impressing on the enamelled surface of metal plates, relief border lines or outlines of required figures, and introducing and burning within such border lines enamel colour.—T.

IX.—BUILDING MATERIALS, CLAYS, MORTARS AND CEMENTS.

Improvements in the Manufacture of Portland Cement, and in Apparatus to be used in the said Manufacture. W. G. Margetts, Aylesford. Eng. Pat. 15,739, November 29, 1884.

THE mixture of chalk and clay, and sometimes the addition of fuel, as prepared by the wash-mill, is ground, not under stones as hitherto, but between hard iron rollers separated from each other by a space equalling one-sixteenth of an inch, one roller revolving twice the speed of the other. The ground mixture is fed into a pyramidal sieve, rotating about its centre axis at a speed of 150 revolutions per minute; the meshes of the sieve are 900 per square inch. The material passing through is thoroughly intermixed, and the larger particles remaining on the sieve are subsequently ejected by centrifugal force into an outer casing, and carried away to be reground. Unless these particles are separated, imperfect mixture results, and the unground masses of chalk are converted into caustic lime during the final calcination, which gives rise to imperfections or "blows" in the work upon which the cement is used, due to expansion caused by the absorption of carbonic acid by the free caustic lime.—C. C. H.

Improvements in the Manufacture of Portland Cement. W. Smith, Dublin. Eng. Pat. 16,950, December 27, 1884.

THE calcareous sands, which occur on the Irish coasts, are mixed with clay or shale in such proportion that when

calcined the mixture shall contain, calcium oxide 60 to 64 per cent.; silica, 20 to 23 per cent.; alumina and oxide of iron, 6 to 12 per cent. The mixture is ground to a fine powder, made into slurry, dried and calcined.

—C. C. H.

Preparation and Treatment of Wood for the Preservation of the Same, and Apparatus therefor. H. H. Lake, London. From J. H. Young, New York. Eng. Pat. 13,294, November 3, 1885.

THIS specification describes improvements in the Thilmany process for the preservation of timber, and apparatus for more effectually and economically carrying the same into effect. A long riveted copper cylinder is employed, in which the timber is placed on trucks running on rails, and secured therein against floating when the solutions used are admitted into the interior. The wood, after being thus secured, is first heated with steam under pressure, which removes the sap from the fibre; the liquid thus extracted is run out of the saturator, and a solution of barium chloride admitted, and kept under a pressure of 100lb. per square inch, until the pores are fully charged. This is succeeded by a similar treatment with a solution of cupric chloride. The improvements in the apparatus are described at length, and consist of the combination of the various appliances—*e.g.*, air and steam pumps, and tackle for expeditiously handling the masses of timber.—C. C. H.

X.—METALLURGY, Etc.

Selenides from the Andes. By F. Hensler and H. Klingner. Ber. 18, 2556.

THE authors examined some samples of selenides from the Andes, said to be the same as those examined by Pisani (*Compt. Rend.* 88, 391). Their results were, however, quite different. The samples consisted of intimately mixed particles, some of silvery brightness, and others darker and leaden; in some samples also, brass and copper-coloured compounds occurred, but the authors restricted themselves to the analysis of the brighter and darker compounds, separated from each other as fully as possible.

Instead of attacking the substance with chlorine (like Pisani), they fused with a mixture of soda and saltpetre. The results of the examination of two bright samples gave per cent.,

	Ag.	Pb.	Cu.	Co.	Se.
1.	19.20	35.70	12.43	trace.	32.77 = 160.10
2.	27.49	17.10	25.10	0.39	29.54 = 98.92

The results of 1. agree fairly with the formula $(\text{Ag}(\text{Cu Pb})_2\text{Se}_2)_n$, [requiring $\text{Ag} = 18.74$, $\text{Pb} = 35.93$, $\text{Cu} = 11.00$, $\text{Se} = 34.33$] and the results of 2. lie between the formulae $(\text{Ag}_3\text{PbCu})_2\text{Se}_4$, CuSe and $(\text{Ag}_3\text{PbCu}_4)\text{Se}_4$. There are smaller differences in the results of the analyses of two samples of the darker portion.

	Ag.	Cu.	Se.	Bi.	Pb.	Co.
3.	15.81	36.30	46.25	1.61		per cent.
	15.93	36.00	—	—		
4.	19.22	35.41	41.58	3.79		"
	19.16	35.77	41.62	3.45		"

The results of 3. (neglecting 2.3 lead selenide) lead to the formula $\text{Ag}_3\text{Cu}_4\text{Se}_{12}$. Those of 4. (neglecting 4.98 lead selenide) indicate the formula $\text{Ag}_2\text{Cu}_4\text{Se}_6$. The authors consider that the above samples are probably of Argentine rather than Peruvian origin.—F. L. T.

Improvements in Metallic Alloys or Compounds, and in Producing the Same. Arthur George Brookes, London. Eng. Pat. 15,644, November 27, 1884.

ALLOYAGES of metals with metallic sulphides.

—W. G. M.

Improvements in the Reduction of Magnesium. Emil von Püttner, Hohenlohehütte, Prussia. Eng. Pat. 1031, January 24, 1885.

THE magnesic mineral is first so treated that the magnesium is present wholly as oxide; it is then mixed very

intimately with carbonaceous matter, to which may be added oxide of iron, and brought to a strong white heat in retorts; the vaporised metal is condensed and collected, similarly to zinc in the extraction of that metal. A reducing or neutral gas may, with advantage, be passed into the retorts during the distillation. The retorts must be very refractory, and are preferably made from highly aluminous bauxite, or clay, and dolomite, or magnesite. The operation is similar to that of zinc extraction, but requires greater care throughout.

—W. G. M.

An Improved Alloy for Mercurial Gilding. George Lowe and Hymen Levetus, Birmingham. Eng. Pat. 1573, February 5, 1885.

FIVE hundred parts of copper are melted without flux, then 100 parts of cadmium and 0.1 part of aluminium are added, the mixture melted to a running heat, and 100 parts of spelter introduced; the whole is well stirred, and finally 300 parts of corrosive sublimate are added, and the alloy run into an ingot. The colour may be varied by altering the proportions of copper. The metal is of good colour, and takes well the gold amalgam used in mercurial gilding.—W. G. M.

An Improved Method for Dressing or Separating Metalliferous Ores. John Davis, Aberystwith. Eng. Pat. 8765, July 21, 1885.

A PERFORATED plunger actuated by double eccentrics, adjustable for varying the length of the stroke, is placed immediately beneath the fixed sieve or plate through which the fine ore is passing. The ore so passed is delivered through the plunger into a receptacle beneath.

—W. G. M.

A Process for the Utilisation of Waste Liquors or Tank-waste containing Calcium Chloride. J. Webster, Birmingham. Eng. Pat. 12,344, October 16, 1885.

A QUANTITY of calcium chloride liquor is run into a vat, and as much slaked lime or calcium carbonate powder thrown into the vat as will absorb the liquor, and the whole is well stirred. The mass becomes of the consistency of mortar, and is then introduced into a drying furnace, to be dried therein at a temperature gradually raised to 250° F. The dried mass is again immersed in calcium chloride liquor, dried again, and immersed and dried for a third time. It will be found that in these three operations, if carefully carried out, the mass will absorb the greatest possible amount of calcium chloride. The resulting substance is next melted and cast into blocks, in order to be used as a flux in metallurgical operations, such as refining copper, brass, nickel, zinc, tin, aluminium, or other metals or alloys. If it is to be used as a flux in the refinement of iron or in the puddling furnace, it is preferable to add 20 per cent. of peroxide of manganese.—S. H.

XI.—FATS, OILS, AND SOAP MANUFACTURE.

Improvements in the Method of Bleaching or Purifying Oil or Grease. M. Ayrton. Eng. Pat. 2381, February 21, 1885.

ONE cwt. of black oil or brown grease is boiled with 16lb. soda, 12lb. soda ash, 4lb. lime, 2lb. alum, 4lb. starch.—W. L. C.

Improvements in the Chemical treatment of Hydrocarbon, for the purpose of hardening and toughening the same. R. Punshon and S. H. Beckles. Eng. Pat. 1958, February 12, 1885.

FOUR parts of the hydrocarbon—preferably ozokerite—are heated with one part of oxidised oil and 3 per cent. powdered sulphur, to about 200° F. An insulating waterproof and acid-resisting material is thus formed.

—W. L. C.

XII.—PAINTS, VARNISHES, AND RESINS.

A New Nitrocellulose Compound and Products therefrom. W. V. Wilson and J. Storey, Lancaster. Eng. Pat. 491, January 13, 1885.

THE invention relates to the production of a new compound consisting chiefly of nitrocellulose dissolved in acetate of amyl and amyl alcohol.

The amyl alcohol employed is potato spirit or fusel oil.

The proportions given are as follows:—

	(a)	(b)
Nitrocellulose	100 pts.	100 pts.
Amyl acetate	150 pts.	400 pts.
Amyl alcohol	150 pts.	400 pts.

As a varnish this mixture is to be used for decorating wood, leather, fabrics, paper, pictures, photographs, &c., and as a stiff paste for the manufacturer of artificial leather, leather cloth, imitation starched linen—i.e., collars, cuffs, fronts, etc. It may be mixed, if desired, with pigment matter and essential oils. For leather cloth the following mixing is given:—

In addition to the afore-mentioned, take of

Castor or Linseed oil	150 pts.
China clay or pigment	100 pts.
Essential oil (any)	1 pt.
Tannic acid	1 pt.

or if intended for collars, cuffs, &c., add

Castor or Linseed oil	75 pts.
Oxide of zinc	125 pts.
Essential oil	1 pt.

The mixing is to be done in rubber or gutta masticators, and the spreading in the way usual in indiarubber manufacture.—H. A. R.

Improvements in Vulcanized Rubber. W. Swartt, Essex. Eng. Pat. 900, January 23, 1885.

UNSUITED for abstracting.—H. A. R.

Preservative Composition for the Bottoms of Iron Ships. H. J. T. Ford, Cardiff. Eng. Pat. 2014, February 13, 1885.

Coating No. 1 is easily applied, and dries in about one hour. It consists of equal parts of coal-tar, American resin, and red oxide of iron melted together, and mixed while warm with one part of petroleum oil and three parts mineral naphtha. When cold enough, rectified CS₂ is added to make the varnish dry quickly, enough "air slaked lime" to give it a good body, and half-a-gallon of copal tar to the hundredweight. Coating No. 2 is made of equal parts of red lead, red oxide of iron, coal-tar and resin melted together, mixed with petroleum oil two parts, and mineral naphtha two parts, also with "enough CS₂ to envelop same" and four pounds of arsenious acid per hundredweight to destroy parasitic life. Another recipe given for No. 2 is as follows:—Bright red iron oxide ground up with one part Stockholm tar and three parts pine varnish to a thick paste. Then is added one part resin, melted and kept in a liquid state by adding mineral naphtha while cooling, and the whole thinned down by methylated spirit containing three pounds garnet shellac per gallon. Two pounds white arsenic, and two pounds of mercuric oxide are added per hundredweight to prevent marine growths.—H. A. R.

Improvements in Pigments from Iron Ore. W. R. Lake, London. From L. Brown, New York, U.S.A. Eng. Pat. 12,568, October 20, 1885.

THE kind of iron ore chiefly proposed to be used is the kind of magnetite known as "sand-iron ore." It is to be reduced to powder. The powder is hard, durable, non-corrosive and fire-proof. When it is to be used as a paint it may be carried by linseed, fish or other oils, soap-water and glue mixed, solutions of asphalt, bitumen, &c. Supplemental colouring bodies are recommended to be used along with the sand-iron ore, since

owing to its great sp. gr. there is a tendency for it to separate from the oil or other medium.

It is claimed that the above paint acts as a protective coating on iron or steel "by forming thereon a coating of magnetic black oxide of iron."—H. A. R.

XIII.—TANNING, LEATHER, GLUE, AND SIZE.

Improved Means for Waterproofing and Preserving Leather, Cardboard, and similar Materials. P. M. Justice. Eng. Pat. 7223, June 13, 1885.

THE materials are saturated or coated with an essence of the white bark of the birch, with or without tallow or neatsfoot oil, and a small proportion of cerosine.—W. L. C.

XV.—SUGAR, GUMS, STARCHES, Etc.

Galactose and Arabinose by Dilute Acids. M. Conrad and M. Guthzeit. Ber. 18, 2905—2907.

10½GRMS. of galactose heated with 4.85grms. of HCl and 50grms. of water, yielded 1.68grms. of humin bodies, 3.32grms. of lactose, 2.85grms. of acetopropionic acid, and 1.08grms. of formic acid. If galactose be heated with dilute H₂SO₄ of the same percentage as the dilute hydrochloric acid, less acetopropionic and formic acids are produced. 10½grms. of arabinose, heated with the above proportion of dilute HCl, yielded 4.3grms. of humin-bodies, 1.24grms. of acetopropionic acid, and 0.42grms. of formic acid.—A. G. G.

On the Sugars of some of the Cereals and of Germinated Grain. C. O'Sullivan, F.R.S. Proc. Chem. Soc., December, 1885.

BARLEY and wheat are proved to contain sucrose and other non-reducing and reducing fermentable sugars, the nature of which was not accurately determined. Germinated barley contains an increased quantity of sucrose, also maltose, dextrose and levulose. The following table is given to show the change that takes place during germination, the results being calculated in percentages on the dry matter of the grain, the yield of dry malt from dry barley being known:—

	No. 1 BARLEY.		No. 2 BARLEY.	
	Before germination.	After germination.	Before germination.	After germination.
Sucrose	0.9	4.5	1.39	4.5
Maltose		1.2		1.98
Dextrose	1.1	3.1	0.62	1.57
Levulose		0.2		0.71

In highly malted barley the sucrose is high; or if not, its place is taken by the products of its inversion. Maltose also is high in highly malted grain, but occasionally its place is taken by dextrose.

With wheat the results are similar.

As high as 11.4 per cent. sucrose, calculated on the solid matter, has been found in unfermented, unacted-upon malt-wort.

In the discussion which followed the reading of the paper of which the foregoing is an abstract,

Mr. BANISTER said that from experiments made on cereals in their laboratory in 1880, he was able to confirm Mr. O'Sullivan's conclusions as to the presence of sucrose in them. The results obtained were published in the second part of South Kensington Art Handbook on the "Analysis and Adulteration of Foods," page 86. A table is there given of the quantity of sugar found in certain cereals, but as this sugar was not isolated, and only examined chemically and optically, it was said of

it on page 87 of the same book, that "The saccharine body behaves like cane-sugar on being inverted with the same facility, and in not reducing a solution of copper salt." Other references are made to this sugar in different parts of the book, and as it was not crystallised out, it would not have been proper to call it cane-sugar, although it possessed all its properties. The amount of the sugar in the cereals examined was determined: the results were as follow:—Wheat, winter sown, 2.57 per cent.; wheat, spring sown, 2.24; barley, long-eared, 1.34; oats, English, 2.36; maize, 1.94; rye, 4.30; rice, Carolina, 0.38.

The quantity of sugar present in the rye is very remarkable, and especially so as it was found that the samples of rye examined contained no sugar having a reducing action upon copper, while in all the others there was a dextrose body present in greater or less proportion.

In 1871 they had to make a series of experiments on malt-worts, and the changes wrought in them by the addition of different quantities of cane-sugar. During that inquiry, evidence was obtained that there was a saccharine substance in malt possessing most of the properties of cane-sugar, and the results then recorded were worked out on the same lines as we now use for expressing copper reducing power, etc., and accord closely with the most recent observations on the subject.

Mr. O'SULLIVAN said that dextrin or malto-dextrin was certainly present, but in very small amount, in malted grain. He added that the peculiarities in rye were probably largely due to the fact that it was usually cut green, and therefore contained bodies which were not fully elaborated.—W. S.

On the Presence of "Raffinose" in Barley. C. O'Sullivan, F.R.S. Proc. Chem. Soc., December, 1885.

IF the alcoholic extract of barley be evaporated, and the syrup dissolved in the least possible quantity of alcohol, and a little ether added, crystals are obtained, which after recrystallisation form flattened rhombic prisms terminated by a dome parallel to the shorter axis. The composition of these crystals is represented by the formula C₁₈H₃₂O₁₆·5H₂O. They melt in a little water, but are not very soluble in strong alcohol. The substance does not reduce an alkaline cupric solution. The optical activity of the anhydrous body is $[\alpha]_D^{20} = +135$; it is slowly inverted by invertase, but rapidly by a 1 per cent. solution of sulphuric acid; the product of inversion readily reduces an alkaline cupric solution. It is fermented by ordinary yeast. With nitric acid it yields mucic, oxalic, and saccharic acids.—W. S.

XVI.—BREWING, WINES, SPIRITS, Etc.

Improvements in Brewing, etc. E. T. Pemberton, Liverpool. Eng. Pat. 16,043, December 6, 1884.

A COMPOSITION is made by mixing one part of gelatin, dissolved in an equal weight of water, with 16 parts of glucose or uncrystallisable sugar at a temperature of 150° F. For brewing, 30lb. of the composition are added to 40 gallons of water, the solution boiled for one hour, hopped, fermented, and racked in the usual way.—C. C. H.

Improvements in Apparatus for charging Beer or other Liquids with Carbonic Acid or other Gases, and discharging the Liquid from the Containing Vessel. Ivan Levinstein, Manchester. Eng. Pat. 16,868, December 24th, 1884.

THIS is an apparatus for keeping fresh and brisk, as well as reviving Lager or other beers, and consists of an arrangement by which the beer is charged with gas, and at the same time may be forced from the cask as required. With the use of the ordinary vent-peg air is admitted, and the latter portions of the liquor thus become flat. The present invention obviates this imperfection, since the admission of air is replaced by the forcing in of carbonic acid. Drawings are given, illustrating the apparatus.

—G. H. M.

XVII.—CHEMISTRY OF FOODS. SANITARY CHEMISTRY, DISINFECTANTS, Etc.

(A) CHEMISTRY OF FOODS.

Analyses of Various Preparations of Meat. A. Stutzer.
Rep. Anal. Chem. 5, 217—218.

Improved Means and Apparatus for the Preservative Treatment of Meat. P. M. Justice, London. From G. Holgate, Philadelphia. Eng. Pat. 1550, February 4, 1885.

FRESHLY-KILLED meat, instead of being exposed, as heretofore, in refrigerating chambers for a considerable period, is placed in an air-tight chamber, from which the

	Water.	Organic Substances.	Salts.	The Organic Matter contains—					
				Nitrogen in the form of albumen, easily soluble.	Corresponding to albumen.	Nitrogen in the form of Peptones.	Corresponding to Peptones.	Nitrogen in the form of albumen, insoluble.	Nitrogen in the form of bases (creatine, creatinine, &c.).
	p. c.	p. c.	p. c.	p. c.	p. c.	p. c.	p. c.	p. c.	p. c.
1.—Kemmerich's Extract of Meat	20.95	60.81	18.24	1.258	7.86	2.308	11.12	—	6.167
2.—Liebig's Extract of Meat	19.33	57.52	23.25	0.818	5.30	0.284	1.77	—	7.782
3.—Murdock's Liquid Food	83.61	15.83	0.56	2.066	12.91	0.037	0.23	—	0.187
4.—Valentine's Meat Juice	59.07	29.41	11.52	0.292	1.82	0.760	4.75	—	1.448
5.—Johnston's Fluid Beef	49.49	45.32	5.19	2.824	17.65	2.837	17.73	0.118	1.391
6.—Benger's Peptonised Beef Jelly	89.68	9.13	0.89	0.386	2.41	0.741	4.63	—	0.122
7.—Savory and Moore's Fluid Beef	27.01	60.89	12.10	0.860	5.43	5.43	2.66	—	7.472
8.—Brand & Co.'s Essence of Beef	89.19	9.50	1.31	0.360	2.25	2.25	6.05	—	0.154
9.—Carnrick's Beef Peptonoids	6.75	87.57	5.50	9.060	56.62	56.62	6.93	0.202	0.100

The salts contain:—

6.56 7.83 0.10 3.76 1.91 0.30 1.49 6.19 1.27 p. c. Phosphoric acid.
8.30 10.18 0.17 5.11 1.72 0.53 1.20 0.20 1.34 „ „ Potash.
0.85 0.84 0.05 0.05 0.84 0.16 2.67 0.06 1.41 „ „ Chlorine.

One hundred parts by weight of Carnrick's beef peptonoids contain as much albumen and peptones as are present in—

178 parts of Johnston's fluid beef.
285 „ „ Kemmerich's extract of meat.
483 „ „ Murdock's liquid food.
765 „ „ Brand & Co.'s essence of beef.
764 „ „ Savory & Moore's fluid beef.
898 „ „ Liebig's extract of meat.
902 „ „ Benger's peptonised beef jelly.
966 „ „ Valentine's meat juice.

Carnrick's preparation contains, in addition to the nitrogenous constituents, 10.67 per cent. of fat, and 10.02 per cent. of soluble non-nitrogenous matters (dextrin and sugar). If the various preparations be arranged in order, according to the proportions of flesh bases present, it is seen that 100 parts by weight of Liebig's extract of meat contain as much nitrogen in that form as—

126 parts of Kemmerich's extract of meat.
537 „ „ Valentine's meat juice.
558 „ „ Johnston's fluid beef.
1844 „ „ Benger's peptonised beef jelly.
4161 „ „ Murdock's liquid food.
5053 „ „ Brand's essence of beef.
7752 „ „ Carnrick's beef peptonoids.

—E. G. C.

Improved Apparatus for and Method of Preserving the Freshness of Animal and Vegetable Substances. B. H. Thwaite, Birkenhead. Eng. Pat. 16,565, December 17, 1884.

THIS apparatus is constructed by placing a number of air-tight vessels for the reception of the substances to be preserved, round a water-chamber; beneath is a hydrocarbon lamp, the space above which is connected with the preserving-chambers, which in their turn are connected at the top with the water-chamber. The substances being placed in the vessels, the lamp is lighted, and the products of combustion are drawn into the chambers, the air at the same time being removed by using the water-vessel as an aspirator.—C. C. H.

air is afterwards exhausted. This opens the pores of the flesh, instead of closing them, as the usual method of refrigerating does, and hence enables sulphurous anhydride (admitted into the chamber and preferably generated from the condensed gas) to more readily penetrate the interior of the flesh. Carbonic acid gas, generated by any known method, but as dry as possible, is also simultaneously or subsequently passed into the chamber. This method, it is claimed, is not only cheaper, but more effectual, and enables the meat to be kept in the air any length of time without its flavour or quality becoming impaired.—C. C. H.

Milk Ripener and Purifier. J. McKerlie, Glenluce. Eng. Pat. 9170, July 31, 1885.

THE apparatus consists of a shallow, oblong tank, carrying, at the lower part of one of its longest sides, a perforated trough and strainer, beneath which is a metallic corrugated sheet. The solid particles are removed by the strainer, and the passage in a thin film over the corrugated sheet reduces the temperature of the fresh milk to that of the atmosphere, and deprives it of "the animal odour and the carbonic acid gas contained in it."

—C. C. H.

(B) SANITARY CHEMISTRY.

Tarred or Asphalted Cast-iron Water-pipes. W. Thörner. Rep. Anal. Chem., 5, 220.

WHEN blisters or flaws occur in the coating of tar, they are found to promote rapid oxidation of the metal beneath, by exposing surfaces to the action of atmospheric air and moisture, and in this way the water passing through the pipes becomes contaminated with hydrated oxide of iron and fragments of tar. This action is prevented by applying to the cast-iron pipes a perfectly even coating of tar or asphalt, free from flaws and bubbles. With this view, the pipes, after casting and subsequent cooling, are treated with an easily-wetting liquid (such as alcohol, petroleum, petroleum ether, crude benzene, etc.), before being coated with, or, still better, dipped in, the hot tar or asphalt. The result is an even layer, free from flaws and crevices. The liquid used must be one

that will easily mix with the tar or asphalt, and which will afterwards easily evaporate from the protecting layer; if this be the case, there will be no danger of any unpleasant taste or smell being imparted to the water.

—E. G. C.

Improvements in the Manufacture of Materials for use in the Purification by Filtration of Sewage, etc. A. Angell, Southampton. Eng. Pat. 13,818, October 18, 1884.

THE mixture of clay and carbonaceous matter employed in the manufacture of this class of materials is usually exposed to the air for a considerable period, or the water is slowly driven off by a gradual heat prior to calcination. To promote the production of a more porous article, the patentee subjects the wet mass to a high degree of heat at once without the gradual drying. —C. C. H.

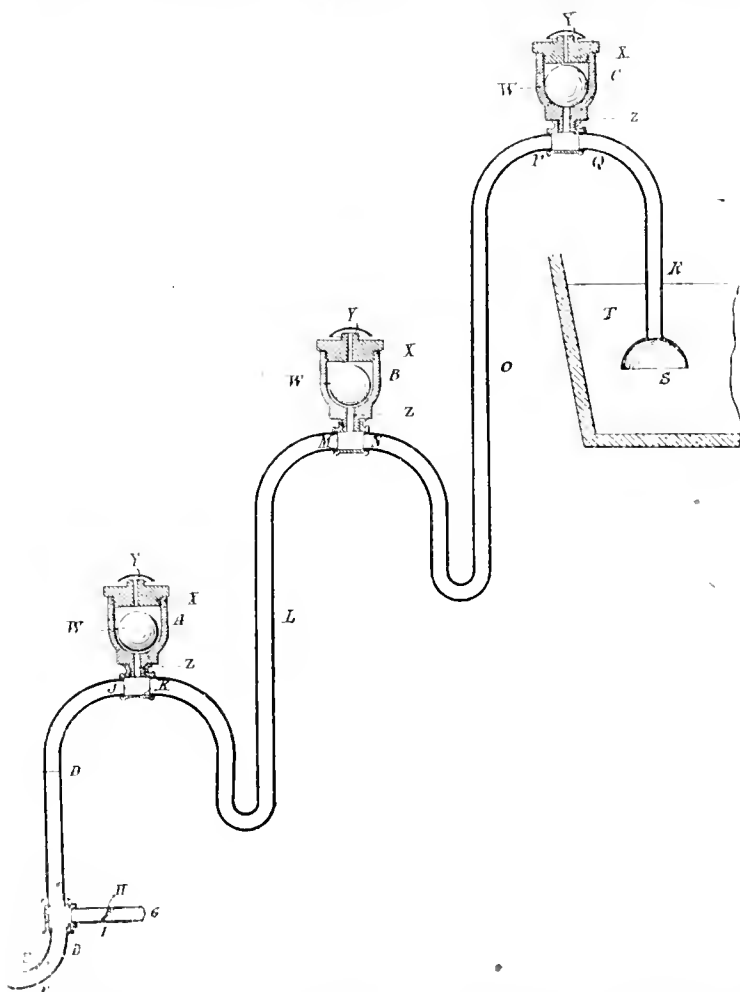
Improved Means for the Purification of Water. J. T. Johnson, London. From A. R. Leeds, Hoboken, U.S.A. Eng. Pat. 14,822, November 10, 1884.

WHEN compressed air is brought in contact with water, the co-efficient of absorption of the oxygen increases

bringing water, in motion and under pressure, in contact with compressed air, increased oxidation of the organic impurities resulting. In the figure annexed, D, L, O, R is a bent pipe, provided at the summit of each bend with an automatic escape-valve; water is forced in at E, and compressed air at G; the excess of air and the products of oxidation escape through the valves below which they accumulate; the water does not escape, because the india-rubber ball-valve floats up and closes the exit. The purified water empties into the tank T, after escaping through a valve placed near S, and loaded to the pressure it is desired to maintain in the pipes. The patentee claims—(1) the process of purifying water described; (2) the combination of apparatus; (3) the series of automatic escape-valves. —C. C. H.

Improvements in the Preparation of an Agent for Use in the Treatment of Sewage, etc. J. W. Slater and W. Stevens, London. Eng. Pat. 15,810, Dec. 1, 1884.

THE mineral called Gibbsite, or any aluminous compound containing a considerable proportion of hydrate of alumina, is treated with hydrochloric acid. The



very rapidly. Thus, at ordinary atmospheric pressure, one litre of water dissolves 6.3cc. of air, containing 65 per cent. of nitrogen and 35 per cent. of oxygen; at 8 atmospheres' pressure one litre of water dissolves 50cc. of air, containing 97.3 per cent. of oxygen and 2.7 per cent. of nitrogen. This fact is taken advantage of in the present case, and the purification of water is effected by

acid solution so obtained is used for the precipitation of sewage, such addition being preceded by the neutralisation of the sewage by lime, and the addition of certain proportions of clay and charcoal ground up together. The patentees claim—(1) the preparation of chloride of alumina; (2) its use for sewage precipitation; (3) its use in conjunction with carbon and clay. —C. C. H.

An Improvement in the Purification of Sewage by Precipitation. J. W. Slater and W. Stevens, London. Eng. Pat. 16,592, December 17, 1884.

SPECIFICATION 15,810, December 1, 1884, by the same authors, prescribed a method of precipitation by the addition to the sewage of clay, carbon, and chloride of alumina. The present specification claims the addition of blood, in a fresh state, to the combination before claimed.—C. C. H.

Improvements in Apparatus for Treating Water with Lime, etc. A. Howatson, London. Eng. Pat. 16,705, December 19, 1884.

A TALL, upright tank, having a vertical centre diaphragm reaching nearly to the bottom, is provided at the top of one division with a tray or perforated plate for the reception of the lime or other solid reagent, and at the bottom with a mechanical agitator. The water to be purified is fed in from an overhead tank, and passing down one side of the vessel is mixed with the purifying agent on the tray, and overflows into a second tank of similar construction to the above-described. The downward division of the second, or settling vessel, is provided at its upper part with an agitator, and its bottom is made sloping, leading to a cock for the reception and discharge of the precipitated matter. The purified water overflows at the upper part of the remaining division of the settling tank. The claim is for the apparatus as described.

—C. C. H.

Improvements in the Method of Separating Micro-organisms and their Germs from Liquids. T. R. Shillito, London. From Dr. K. Moller, Brackwede. Eng. Pat. 545, January 14, 1885.

THE liquid is first passed through an ordinary filter to separate mechanical impurities, and afterwards through any suitable fibrous material—e.g., asbestos, slag-wool, paper, etc., compressed until the pores are so small that micro-organisms cannot pass through. This medium may be purified by ignition, treatment with acids, or by heating in vapours at a temperature of from 100 to 160° C.—C. C. H.

Improvements in Purifying and Utilising Sewage. H. Wagner and A. Müller, Berlin. Eng. Pat. 629, January 16, 1885.

THE sewage is defecated with lime, and the sludge separated by filtration of the whole through endless bands of wire cloth and felt. The alkaline filtrate is passed through an apparatus in which a high vacuum is maintained, wherein it is exposed in thin layers in a series of trays. The ammonia given off is absorbed by a continuous stream of sulphuric acid similarly exposed in the same apparatus. The sludge separated may be used, after drying, directly as a manure, or after separation of the fibrous and fatty matter, it may be burned in a gas generator fed by a blast of steam, and the ammonia formed absorbed in a scrubber.—C. C. H.

Improvements in Purifying and Decolorising Sewage and Other Foul Waters, and obtaining a Useful Product therefrom. F. Maxwell Lyte, Putney. Eng. Pat. 900, January 21, 1885.

DEFECATION is effected by the addition to the sewage or water of a soluble aluminate, preferably sodium aluminate in a powdered form. If the water or sewage does not contain sufficient acid to combine with the base and liberate hydroxide of alumina in the mixture, a small quantity either of a mineral acid, an acid salt of alumina, or of potash or soda, may be added. For ordinary sewage from 6 to 7 grains each of commercial sodium aluminate and aluminium sulphate per gallon will be found sufficient.—C. C. H.

Purifying Water, etc., and Apparatus therefor. W. E. Geigel, London. From F. Wolff & Co., Bremen. Eng. Pat. 1144, January 27, 1885.

THE water is percolated through a vessel packed with peat.—C. C. H.

Improvements in the Treatment of Human Excrements, Sewage, etc. C. Lehofer, Bournemouth. Eng. Pat. 5227, April 28, 1885.

UNSUITED for abstracting.—C. C. H.

Improvements in the Preparation of Precipitants for use in the Treatment of Sewage, etc. W. G. B. Bennet, Portswood. Eng. Pat. 6055, May 16, 1885.

"CARBONISED clay" or "carbonised earthy deposit," is reduced to an impalpable powder and treated with sulphuric acid sufficient in quantity to render the iron and aluminous compounds present soluble. The "acidified carbon" is then added to the sewage after the latter has been rendered alkaline.—C. C. H.

Improvements in Method and Apparatus for Dedicating Vegetable and Animal Matter. B. L. Ryder, Chambersburg, Pennsylvania. Eng. Pat. 7352, June 16, 1885.

THE apparatus consists of three flues sloping slightly upwards, rectangular in section, and communicating with each other at alternate ends. The lower flue communicates at one extremity with a desiccating furnace. The fruit or substance to be dried is submitted successively in the three flues to the action of a current of hot air supplied by the furnace. Sulphurous anhydride may be also introduced into the middle or other of the flues to whiten or bleach the desiccated bodies.—C. C. H.

Improvements in the Treatment of Sewage. S. H. James, Tottenham. Eng. Pat. 8084, July 3, 1885.

THE patentee describes, and claims as his improvements—"The mechanical pumping or forcing air through sewage matter (whether precipitated or not) for the purpose of deodorising and purifying the same, and the disposal of the vitiated air and noxious gases evolved in the process by means of pipes or chimnies, discharging the same at a sufficiently high elevation to be unobjectionable."—C. C. H.

Filtering Material for Purifying Water from Nitro-organisms. O. F. Öberg, Stockholm. Eng. Pat. 8282, July 8, 1885.

POROUS carbon blocks are immersed in a boiling solution of an alkaline silicate, dried, and then submerged in a boiling solution of either sulphate of alumina or calcium chloride. The blocks are now dried, after which they are ready for use.—E. G. C.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

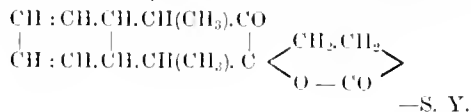
Action of Hydrogen Peroxide on Antimony Sulphide. By F. Raschig. Ber. 18, 2743.

CLASSEN and Bauer showed (Ber. 16, 1061) that precipitated antimony sulphide treated with hydrogen peroxide and ammonia yields all its sulphur as sulphuric acid, the antimony partly remaining as a white precipitate, and partly going into solution. The author finds that only a small quantity of the antimony remains undissolved as antimonic acid, the bulk going into solution as ammonium antimonate. From this solution, increase of temperature, or addition of alcohol, precipitates ammonium antimonate $\text{NH}_4\text{SbO}_3 + 3\text{H}_2\text{O}$, identical with Frémy's ammoniummetantimonate, $\text{H}_2(\text{NH}_4)\text{Sb}_2\text{O}_7 + 5\text{H}_2\text{O}$. The

author finds the solution of ammonium antimonate convenient for preparing those metallic antimonates that are not precipitated by ammonia.—F. L. T.

On the Constitution of Santonin. S. Cannizzaro. Ber. **18**, 2746–2751.

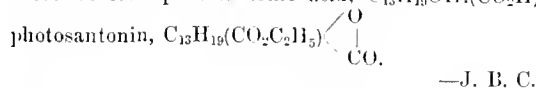
AFTER a review of the evidence so far obtained regarding the constitution of santonin, the following formula is proposed, as one fairly in accord with the reactions:—



Derivatives of Santonin. V. Villavecchia. Ber. **18**, 2859–2864.

THE author has studied photosantonin acid, discovered by Sestini, and his results confirm the view that it is the agency of light which induces the change in a solution of santonin, forming photosantonin and photosantonin acid.

Photosantonin acid is obtained by exposing an acetic acid solution of santonin to the light. The liquid becomes yellow, and on evaporation is found to contain the new acid. It forms well-defined salts. On exposing an alcoholic solution of santonin to the light, photosantonin is formed, as well as an isomeric body. The author assigns the following constitutional formulae to these bodies: photosantonin acid, $\text{C}_{13}\text{H}_{10}\text{OH} : (\text{CO}_2\text{H})_2$;

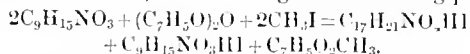


The Quantity of Bromine in Sea-Water. E. Berglund. Ber. **18**, 2888–2890.

AS the results obtained by previous observers disagree considerably, the author has made a new series of determinations of the quantity of bromides in sea-water by means of his new method of estimating bromides in presence of chlorides (*Zeit. Anal. Chem.* **24**, 184–195, also 196–199). He finds that the ratio of bromine to 100 parts of chlorine contained in the water only varies in different parts of the world between 330 and 344. This result agrees with the numbers found by Dittmar in the Challenger expedition, but it differs greatly from the results of other observers.—A. G. G.

Artificial Preparation of Cocaine. W. Merck. Ber. **18**, 2952–2955.

THE author prepares cocaine by heating ecgonine with benzoic anhydride and methyl iodide for ten hours in a closed tube to 100°, the following reaction taking place:



A resinous mass is formed containing benzoic ether. After heating with water the ether separates as an oil, and the aqueous solution may be poured off.

After extracting with ether to eliminate benzoic acid, the clear solution is shaken up with AgCl to free it from iodine, and the hydrochloride of the base is precipitated as a crystalline double salt with PtCl₄.

Benzoyllecgonine readily forms cocaine by heating with methyl iodide, and so introducing a methyl group. In order to obtain the homologues of cocaine, the author substituted ethyl iodide, and obtained a brown product, which was purified with difficulty, and contained a new base, having the formula, $\text{C}_{18}\text{H}_{23}\text{NO}_3$, to which the name "cocethyline" has been given. It forms double salts with AuCl₃, HgCl₂, PtCl₄, etc.—J. B. C.

Reduction of Nicotine. A. Liebrecht. Ber. **18**, 2969–2970.

THE author reduced nicotine with sodium and alcohol, and distilled the product with steam—a base distilled

over differing essentially from nicotine. It forms soluble double salts with HgCl₂ and PtCl₄. An analysis of the Pt double salt gave the formula $\text{C}_{16}\text{H}_{26}\text{N}_2$. Six atoms of H have therefore been added, and the body formed probably bears the same relation to piperidine that dipyrindyl does to pyridine. It has therefore been named "dipiperidyl."

Dipyrindyl, $\text{NC}_5\text{H}_4 - \text{C}_5\text{H}_4\text{N}$; dipiperidyl, $\text{NC}_5\text{H}_{10} - \text{C}_5\text{H}_{10}\text{N}$. It is a secondary base, forming a nitroso compound.—J. B. C.

Improvements in the Method of and Apparatus for the Manufacture, Distillation, and Concentration of Alcohol, Hydrocarbons, and Acetic Acids. Donald Daniel Cattanaeh. Eng. Pat. 11,258, Sept. 22, 1885.

THE object of the invention is to provide a process and apparatus by which alcohol and other spirits, of any required degree of purity, may be cheaply produced, and hydrocarbons purified, at any and all times, with an apparatus simple in construction. The essential feature of the invention is the use of pure, dry, heated air in closed vessels in contact with the vapour arising from the materials to be distilled. There are fifteen claims in the patent.—T.

Improvements in the Separation and Obtaining of Oxygen and Nitrogen from Atmospheric Air. L. Q. Brin and A. Brin, Paris. Eng. Pat. 157, Oct. 5, 1885.

ATMOSPHERIC air freed from moisture and carbonic acid is passed through retorts containing heated anhydrous oxide of barium free from carbonates and nitrates. Here the oxygen is absorbed, while the nitrogen passes on to a receiver. When the baryta can absorb no more oxygen the retorts are disconnected with the air supply and the nitrogen receiver, and are connected with the oxygen holder. Increased heat is now applied to the retorts, and a partial vacuum created in the oxygen-holder. This causes the liberation of the absorbed oxygen, leaving the baryta ready for a repetition of the process.—A. R. D.

XXII.—GENERAL ANALYTICAL CHEMISTRY.

Production of Sulphuretted Hydrogen free from Arsenic. F. Gerhard. Rep. Anal. Chem. **5**, 214–215.

THE author strongly recommends the method of preparing this gas consisting in warming a solution of magnesium sulphhydrate, which has been made by passing ordinary sulphuretted hydrogen into water containing magnesia in suspension; he calls attention, however, to the disadvantage that this mode of preparing the solution of the magnesium salt is troublesome and tedious, and he states that a much simpler plan is to mix the alkaline or calcium hydrosulphide with an equivalent amount of a solution of magnesium sulphate or chloride. The result is a solution containing magnesium hydrosulphide, together with the alkaline or alkaline earthy salt. This solution, when warmed over a gas-burner or placed in a vessel standing in hot water, liberates sulphuretted hydrogen, freely and evenly.—E. G. C.

Determination of Small Quantities of Sodium Chloride in the Presence of Potassium Chloride. F. Röttger and H. Precht. Ber. **18**, 2076–2078.

THE method is based upon the greater solubility of sodium chloride in 90 to 95 per cent. alcohol as compared with that of potassium chloride: 100 parts of 90 per cent. alcohol at 15° C. dissolving 0.345 NaCl and 0.073 KCl.

The finely-powdered sample (20grms.) of mixed salt is extracted with sufficient alcohol, $\frac{1}{2}$ cc. of 10 per cent. potassium carbonate solution added to the extract to precipitate any magnesium chloride, which is then filtered off, the filtrate evaporated in a platinum dish to dryness, gently ignited and weighed. The KCl is determined in this, in the usual way with platinum chloride and the NaCl calculated as difference. The result is accurate to $\frac{1}{1000}$ th per cent. The amount of platinum chloride necessary for the determination by this method

is very much less than that required by the older processes, an important point where many analyses have to be made.—T. L. B.

Separation of Iron from Aluminium. M. Hlinski and G. v. Knorre. Ber. 18, 2728.

THE facts on which the separation depends are:—

Nitroso- β -naphthol produces in solutions of ferric salts a bulky dark-brown precipitate of the composition $(C_{10}H_6ON_2O)_3Fe$, soluble in mineral acids and in glacial acetic acid, but insoluble in 50 per cent. acetic acid solution, and being quantitatively separated in the cold from solutions to which not more than 10 per cent. of hydrochloric acid solution (sp. gr. 1.12) have been added.

From solutions containing ferrous salts nitroso- β -naphthol separates the iron as a dark-green precipitate in the absence of free mineral acid.

No compound of alumina with nitroso- β -naphthol has as yet been obtained.

To perform the analysis:—To the previously concentrated solution containing the iron (ferric) and aluminium as chlorides or sulphates, ammonia is added till a slight permanent precipitate is produced, which is dissolved by a few drops of hydrochloric acid. Then to the cold liquid an equal bulk of 50 per cent. acetic acid is added with stirring, and an excess of nitroso- β -naphthol (dissolved in 50 per cent. acetic acid).

After standing six to eight hours the liquid is filtered, washed firstly with 50 per cent. acetic acid and then with cold water. After drying, the filter containing the precipitate is placed in a tared porcelain crucible, crystallised oxalic acid approximately equal in bulk to the precipitate is added, the filter closed, and the whole gently heated. The method of incineration recommended is to leave the loosely-covered crucible on a piece of asbestos board heated by a small flame till no more fumes are given off, then to ignite strongly, with access of air till all carbon is burnt. Weigh as ferric oxide. It is easy to incinerate the precipitate in this way without loss. If no oxalic acid is added the precipitate decrepitates.

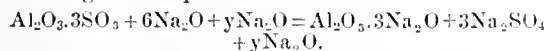
The check analyses are good.

The separation cannot be performed in presence of phosphoric acid.

Nitroso- β -naphthol is a very delicate test for ferrous salts, giving a fine green colouration with water containing only three milligrammes of iron per litre.—F. L. T.

New Method for the Determination of Alumina. K. J. Bayer. Zeits. Anal. Chem. 24, 542, p.

NORMAL soda solution is added to a given quantity of alum solution, until the precipitate at first formed has completely redissolved. An alkaline alumina solution is thus obtained, containing the sulphates of sodium and potassium. Litmus tincture is added, and the mixture is exactly titrated with normal sulphuric acid. The number of cc. required will be considerably smaller than the number of cc. of normal soda already used, according to the equation—



The difference between the normal sulphuric acid used in the titration and the normal soda at first added gives the quantity of soda corresponding to the sulphuric acid required by the alumina present.—E. G. C.

Separation of Zinc from Cadmium by Electrolysis. S. Eliasberg. Zeits. Anal. Chem. 24, 548, p.

THE author has tried the process described by A. Iver (*Bull. Soc. Chim. de Paris*, 34, 18), according to which a solution of the acetates or sulphates of the metals is treated with 2–3 grms. of sodium acetate and a few drops of acetic acid, and then, after warming, decomposed with the aid of two Daniell's elements; and he finds that, unless the solution is kept warm during the entire period of the electrolytic action, the cadmium is not completely

separated. It is also remarked by him that two Bunsen's cells, with a resistance interposed, and producing a current capable of liberating 0.5–0.6 cc. of oxy-hydrogen per minute, are preferable to two Daniell's elements, the current from which is not powerful enough for the required purpose. Other batteries may of course be used. The fluid to be electrolysed should not measure more than 90 cc., and the operation must, according to the author, occupy not less than six hours. This is considerably longer than the time mentioned by A. Iver. Some results obtained by the author are here given:—

TAKEN.		CALCULATED.	FOUND.
ZnO.	CaO.	Ca	Ca
grm.	grm.	grm.	grm.
0.1416	0.2070	0.1811	0.1814
0.1593	0.2171	0.1889	0.1890
0.1318	0.2147	0.1878	0.1865
0.2038	0.2577	0.2255	0.2267
0.1931	0.2431	0.2127	0.2130
0.2314	0.2371	0.2077	0.2082
0.2152	0.2094	0.1832	0.1822

—E. G. C.

On the Decomposition of Silicates by means of Alkaline Carbonates. F. Stolba. Ber. Königl. Böhm. Gesells. October, 1885.

THE author finds that rapid solution of the separated alkaline silicates, and their removal from the platinum crucible, are promoted in an extraordinary degree by the addition to the completely fused mass of from half its volume to its own volume of sodium chloride. The covered platinum crucible is now heated until the mixture is quite fluid. Treatment with hot water, and exceedingly rapid solution, follow; hydrochloric acid is next added, and the evaporation to dryness is proceeded with in the usual manner.—E. G. C.

New Books.

FRESenius' QUANTITATIVE ANALYSIS. Vol. II. Part II. Translated by Chas. E. GROVES, F.R.S. J. & A. Churchill, 11 New Burlington Street, London.

THE appearance of Part I. of the translation of Fresenius' important work by Mr. Groves, F.R.S., we announced in this Journal, vol. iv. p. 138. The issue of Part II. will consequently be hailed with satisfaction. The pamphlet form is continued, 8vo size, and the price of each part is 2s. 6d. The subject of Organic Chemical Analysis is continued and completed on page 112. In this branch, however, are included the following: Deduction of Empirical Formulae, pp. 101–104; Deduction of Rational Formulae, pp. 104–112. A special part now follows, devoted to the Analysis of Waters, I.; Analysis of some Technical Products and Minerals, with Processes for Estimating their Commercial Value, II. Under the latter heading the subject of *Acidimetry* is first taken up and continued to page 192, where Part II. ends with the *Preparation of Normal Oxalic Acid*, the consideration of which will be continued in Part III.

THE GAS ENGINEER'S POCKET ALMANACK AND LIGHTING TABLE FOR THE YEAR 1886. Issued by WILLIAM SUGG & Co. Limited, Engineers, Vincent Street, Westminster, S.W. : 1 and 2, Grand Hotel Buildings, Charing Cross, S.W. : Crystal Palace, Sydenham ; and Paris.

SMALL 8vo volume—pocket-book form, bound in morocco leather, gilt, and fastened with elastic band, price 2s. 6d. The book commences with a Calendar for 1886 ; then follows an article on the Lighting and Extinguishing Street Lamps, etc., which contains a table giving the Monthly Totals of Lamplight for the yearly totals of 4300, 3940, and 3836 hours. A useful Diary for gas managers now appears, so that besides the varieties of coals used in the mixtures for the retorts, there can be entered up the makes of gas for each day of the week, the volumes in stock in the holders, and the amounts sent out. A Glossary of Terms in most frequent use in connection with Gas Works, with their equivalents in the French and German, is the next item, and this is followed by the NOTIFICATION OF THE METROPOLITAN GAS REFEREES as to the times and modes of testing for illuminating power. Well-illustrated descriptions of all the apparatus recommended by the Gas Referes, with tables for reference, etc., are given. Blank pages for Memoranda, divided for the months of the year, are usefully arranged next in order, and then, all the items required to be entered up and summarised each month in a Gas Works are printed and ruled off on alternate double pages, blanks being left only for the figures, so as to make the whole a complete and universally useful little reference book for gas managers. The little work concludes with a few tables of equivalent weights, measures, and prices, etc., and finally, with some Interpolation Curve tables which have been calculated and arranged by Mr. Jas. T. Brown. These have the effect of rendering Sugg's Lighting Table applicable to all parts of the world.

CHEMICAL EQUILIBRIUM, THE RESULT OF THE DISSIPATION OF ENERGY. By G. D. LIVEING, M.A., F.R.S. Deighton, Bell & Co. Cambridge ; George Bell & Sons, London. 1885.

8vo VOLUME, bound in cloth, containing 97 pages of subject matter, lithographic plate showing the position of certain lines in the spectrum, and photographic plate showing lines, when the light of the electric arc is dispersed by prisms of caespar. A general idea may be formed of the mode of treatment of the subject from the following abstract of the table of Contents :—Chapter I. *Introductory*. II. Equilibrium in Dissociation. III. Termination of Reactions. IV. The Nascent State. V. The Passage from one state of Equilibrium to another. VI. Theoretical View of the Nature of Chemical Combination.

Monthly Patent List.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

1885.

15686 W. M. Fraser, Glasgow. Improvements in furnaces and apparatus for burning liquid fuel. Complete specification. December 21

15709 A. Attwood, London. Improvements in continuous power presses for making cartridges or pellets of gunpowder, line, coffee, tea, and other concrete substances. Dec. 21

15713 S. H. Johnson and C. C. Hutchinson, London. Improvements in subsidence apparatus. December 21

15762 A. G. Martin, London. Method of and apparatus for obtaining superheated steam at a constant temperature. August 5

15531 H. Podger and G. Bryant, London. Improvements in the make and construction of apparatus for heating air. December 21

15865 W. R. Jones, Westminster. Improvements in duplex furnaces specially adapted for burning breeze and inferior fuel. Complete specification. December 21

15873 F. Bruggemann and L. Donkers, London. Improvement in or applicable to internally-heated boilers for the purpose of economising fuel. Complete specification. Dec. 21

15598 J. T. Griffin, London—Communicated by J. W. Hatch, United States. Improvements in and relating to furnaces, in apparatus to be used therewith, and in utilising solid and gaseous fuel therein. December 24

15599 Cordner, Allen & Co., London—Communicated by P. Gaillot, France. Improvements in apparatus for separating liquid from solid matters suspended therein. December 29

15972 N. H. Humphrys, Westminster. Improvements in apparatus for preventing explosions of steam boilers and the regulation of fluids under pressure or exhaust. December 29

16014 J. Laidlaw and A. J. Liversedge, Glasgow. Improvements in the construction of centrifugal machines, otherwise known as hydro-extractors. December 30

16035 J. N. Longden, London. A construction of crucibles, retorts, and other vessels that are subjected to high temperatures. December 30

16036 J. N. Longden, London. Construction of furnaces for treatment of ores and metals. December 30

16037 J. N. Longden, London. Apparatus for condensation of furnace fumes. December 30

16065 G. A. Bishop, Coatbridge, N.B. Improved firebricks, retorts, crucibles, and other fire-resisting articles of a similar nature. December 31

1886.

96 S. Fox, London. Improvements in apparatus for generating or producing and utilising gases. January 1

119 W. Begg, Manchester. Improvements in the construction of furnaces. January 5

183 F. White, London. Improvements in means employed for consuming smoke passing from the grates of furnaces and preventing the emission of smoke from furnaces. January 5

221 J. P. Marsh, Liverpool. Improved self-acting valve, applicable for use in chemical works, to prevent the return of liquor when force or pressure is exerted in an opposite direction. January 6

266 R. Wainwright and W. Wainwright, London. Improvements in the construction of furnaces for effecting the consumption of smoke. January 7

298 C. T. Colebrook, London. Improvements in or applicable to self feeding and smoke-consuming furnaces. January 7

382 J. Watson, London. Improvements in apparatus for burning oils or liquid fuel in steam-boilers. January 9

397 H. Stockheim, London. Improvements relating to filtration and apparatus therefor. January 9

403 J. L. Sampson and J. Hart, London. Improvements in furnaces. January 9

404 J. L. Sampson and J. Hart, London. Improvements in apparatus for feeding fuel to furnaces. January 9

406 H. C. Swinnerton Dyer, London. Improvements in regenerative furnaces. January 9

599 N. Evans, Liverpool. Improvements in and in connection with apparatus for supplying air to furnaces and combustion chambers, more particularly of steam generators. Complete specification. January 11

672 A. Neubecker, London. Improvements in refrigerating machinery or apparatus. January 15

713 B. Spencer and J. Driver, Halifax. A method of and apparatus for condensing smoke in steam boilers, and utilising the products for heating and other purposes. January 16

902 T. Curtis, Glasgow. Improvements in the modes and means, or apparatus for, refrigerating or cooling liquids. January 20

907 A. Howatson, London. Improved methods of arranging plates or appliances in vessels used for separating solid impurities from water or other liquids. January 20

COMPLETE SPECIFICATIONS ACCEPTED.*

1885.

1510 G. Fletcher and W. P. Abell. Centrifugal machines for drying crystalline or granular substances. December 22

3133 J. Inray—Communicated by H. Remaury and F. Valton. Manufacture and application of materials for lining furnaces and metallurgical vessels or utensils. January 8

14491 W. T. Cortin. Stop valves for use with chemical fluids. January 15

15252 P. M. Justice—Communicated by C. Dietzsch. Process and furnaces for burning limestone or lime, and similar materials. January 12

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

1885.

15574 F. Wright, London. Improvements in apparatus for determining the illuminating power of gas. December 18

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Specifications thus advertised are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

- 15614 W. Menzies, Newcastle-on-Tyne. Improvements in artificial fuel for marine and other steam boilers. Dec. 19
 15706 E. Blass, London. Improvements in water-gas apparatus for distillation of the fresh fuel. December 21
 15759 S. W. Allen and G. Breilit, London. Improvements in the process of making compressed fuel from small coal and pitch or other similar materials. December 22
 15768 A. M. Clark, London—Communicated by J. S. Lenz, United States. Improved process for manufacturing illuminating gas. December 22
 15780 H. H. Lake, London—Communicated by H. K. Flagler, United States. Improvements relating to the utilisation of fuel in a comminuted condition, and to apparatus therefor. December 22
 15803 S. Banner, Liverpool. Improvements in or appertaining to the manufacture of mineral illuminating oil. Dec. 23
 15832 S. Chandler, S. Chandler, jun., and J. Chandler, London. Improvements in regenerative gas lamps or lanterns. December 24
 15850 J. Lewis, London. An improved application to gas burners for increasing the illuminating power of gas enriched with other gaseous compounds. December 28
 16052 W. Young, Glasgow. Improvements in the purification of coal-gas and in apparatus therefor, the same being in part applicable for the preparation of caustic ammonia solutions. December 31
 16081 H. H. Blackmore, London. An improved method and apparatus for producing gas from petroleum or other oils or chemicals. December 31

1886.

- 128 B. H. Thwaite, Liverpool. Improvements in methods of supplying air to gas or other burners for illuminating purposes. January 5
 176 H. J. Haddan, London—Communicated by J. T. Wethered, United States. Improvements in apparatus for the manufacture of illuminating gas. January 5
 197 G. F. Redfern, London—Communicated by J. Lacoste, France. An apparatus for indicating the escape of illuminating and other gas. January 5
 292 A. Gutensohn, London. Improvements in the manufacture of artificial fuel and fire-lighters. January 7
 251 C. Wells, London. An improved candle. January 8
 352 C. Wells, London. An improved multiple-wick candle. January 8
 389 C. Wells, London. Improvements in candles. Jan. 9
 451 J. Parkes, Birmingham. Improvements in apparatus for enriching illuminating gas. Complete specification. January 12
 495 S. Banner, Liverpool. Improvements in the manufacture or blending of burning oils. January 12
 603 S. Banner, Liverpool. Improvements in the manufacture, blending, or treatment of certain mineral hydrocarbons or compounds of hydrocarbons. January 14

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 2104 J. F. Braidwood. Means and apparatus for closing the mouths of gas-retorts, etc. January 8
 2679 W. Boggett. Apparatus for burning oils and fats with or without admixture of gas for the production of light and heat. December 22
 3323 T. Alexander, S. Alexander, and R. Paterson. Apparatus for making oil-gas. January 22
 3908 A. T. D. Berrington. Method of regenerating waste gases. January 15
 15686 W. M. Fraser. Furnaces and apparatus for burning liquid fuel. January 22

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

COMPLETE SPECIFICATION ACCEPTED.

1885.

- 2693 F. J. Rowan. Distilling and obtaining useful products from coal or other carbonaceous mineral, and apparatus therefor. January 15

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

1885.

- 15632 W. Smith, London. A new vegetable blue dye. December 19
 15716 C. Rudolph and O. Gurke, London. Improvements in the manufacture of colouring matters. December 21
 15775 H. H. Lake, London—Communicated by The Schoellkopf Aniline and Chemical Company, United States. Improvements in and relating to colouring matters. Complete specification. December 22
 15781 H. H. Lake, London—Communicated by The Schoellkopf Aniline and Chemical Company, United States. Improvements in and relating to colouring matters. Complete specification. December 22

1886.

- 38 B. J. Cresson, London. Improvements in dyeing and printing aniline black and in the solutions used therefor. January 1

- 43 C. D. Abel, London—Communicated by C. Roth, Germany. Improvements in the production of colouring matters or dyestuffs. January 1
 510 A. Brunstein, London. Improved method and apparatus for obtaining alizarin oil from oleaginous seeds. January 12
 765 J. V. Johnson, London—Communicated by A. Faust, Germany. Improvements in the manufacture or production of para- and ortho-nitrobenzylalcohol and para- and ortho-nitrobenzyldehyde. January 18

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 3119 H. J. Haddan—Communicated by the Farbenfabriken vormals F. Bayer & Co. Blue and violet colouring matters. December 25
 14232 E. Elsaesser. Manufacture of azo-dyestuffs or colouring matters. December 29
 11802 A. L. Hughes, J. Bartley, and F. Best. Improvements in laundry blue. January 5

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

APPLICATIONS.

1885.

- 15705 C. E. Mey, London. Process for coating paper and woven fabrics with waterproof material, said process being specially applicable in the manufacture or treatment of shirt collars, cuffs, and fronts. December 21
 15717 W. R. Lake, London—Communicated by F. E. J. Dubar, France. An improved textile fabric. December 21
 15809 T. R. Shillito, London—Communicated by R. Baur, Germany. An improved process for the treatment of flax, hemp, china grass, and similar vegetable fibrous materials in order to obtain fibres. December 23
 15871 E. Edwards, London—Communicated by T. G. Meili, Germany. An improved process or system for the manufacture of waste cotton yarns. December 24
 15906 T. F. Wiley, Bradford. Improvements in the method or process of treating textile fabrics to render them waterproof. Complete specification. December 28
 15947 F. Candy, London. Improvements in the preparation of fuller's earth for use in manufactures. December 28
 15948 F. Candy, London. Improvements in the treatment and utilisation of a certain kind of clay. December 28

1886.

- 322 W. H. Maitland, London. Improvements in treating wool in order to destroy burrs or other vegetable substances mixed therewith. January 8
 564 O. Chemin, London. Improvements in the treatment of animal fibres or mixed fabrics, to remove vegetable matters therefrom. January 13

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

1885.

- 15637 J. Menzies, Glasgow. An improved oleaginous liquid to be used for batching fibrous substances and in dyeing operations. December 19
 15761 H. J. Haddan, London—Communicated by J. F. Meyer and G. Klinkenberg, Germany. Apparatus for dyeing felt and woven fabrics. December 22

1886.

- 38 B. J. Cresson, London. Improvements in dyeing and printing aniline black and in the solutions used therefor. January 1
 83 W. Bracewell, Brinscall, Lancashire. Improvements in apparatus for kiers used in bleaching. January 4
 597 R. H. Ainsworth and E. B. Manby, London. Improvements in machinery to be used in bleaching quilts and other heavy or light fabrics and yarns, by the "Thompson" or other analogous processes, which are also applicable to dyeing purposes. January 11
 617 W. Stewart, Glasgow. Improvements in calico printing machines. January 11

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 3219 J. A. Ashwell. Process of dyeing hosiery, etc., and apparatus therefor. December 29
 1148 J. Farmer—Partly communicated by A. Lalauze. Apparatus for washing, chloring, scouring, etc., woven fabrics. January 12

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

1885.

- 15661 T. R. Shillito, London—Communicated by E. Hanisch and M. Schroeder, Prussia. An improved process for separating substances from phosphate of lime. December 19

15836 N. M. Henderson, Broxburn, N.B. Improvements in apparatus for distilling ammonia. December 24
 16007 A. Whittle, Swinton, Lancashire. The utilisation of a chemical refuse, known as vat refuse or gas lime. December 30

1886.

46 E. W. Parnell and J. Simpson, Liverpool. Improvements in the production of pure carbonic acid gas. January 2
 47 E. W. Parnell and J. Simpson, Liverpool. Improvements in the manufacture of carbonate of soda, with production of sulphuretted hydrogen. January 2
 48 C. Wigg, Liverpool. Improvements in the manufacture of bicarbonate of soda, and in apparatus therefor. January 2
 63 G. Jarmay, London. Improvements in separating the ammonium chloride from liquors obtained in the manufacture of soda by the ammonia process. January 2
 65 L. Mond, London. Improvements in obtaining ammonia and hydrochloric acid from ammonium chloride. January 2
 66 L. Mond, London. Improvements in obtaining ammonia and chlorine from ammonium chloride. January 2
 150 T. Robinson, Glasgow. Improvements in the manufacture of alum and sulphate of alumina. January 5
 180 John Addie and James Addie, Glasgow. An improved process for the production of sulphurous acid gas. January 5
 159 J. E. Bennett, London. Improvements in the treatment of metallic chlorides for the production and extraction of metallic bases. January 5
 227 N. Matheson and J. Hawliczek, London. Improvements in the manufacture of carbonate of soda and soda ash. January 6
 480 W. Wilson, London. Improvements in the purification of acetate of lime. January 12
 676 A. Deckers and R. Tamine, Liverpool. Improvements in the treatment of crude phosphate of lime. January 15
 715 W. B. Giles and A. Shearer, London. Improvements in the manufacture of phosphoric acid. January 16
 719 A. Oschenbruck, London. Improved method for the manufacture of anhydrous ammonia, and for the utilisation thereof for the production of cold or of work, or of both cold and work together. January 16
 872 P. Thomas, London. Improvements in apparatus for producing sulphurous acid in solution. January 20
 903 F. B. Hawes, London. A new or improved manufacture of sulphuric acid from certain sulphides. January 20

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

2578 H. Simon—Communicated by the Berlin Anhaltische Maschinenbau-Actien Gesellschaft, Germany. Apparatus for the distillation of ammonia from ammoniacal liquors, and for the treatment of the resulting ammoniacal vapours. January 8
 3098 J. Wilson. Decomposing liquors containing chloride of magnesium. December 29
 4290 W. J. Chrystal. Manufacture of chromates and bichromates. January 19
 5882 A. Boake and F. G. A. Roberts. Manufacture of potassium sulphates. December 29
 14780 L. E. L. J. B. Régi and L. M. C. Folie-Desjardins. Process and apparatus for the manufacture of sulphuret of carbon, and alkaline chlorides and silicates. January 22

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

1885.

15743 H. Standen, Harlesden. The manufacture of glass for sanitary and other purposes. December 22
 16098 M. Ritter von Spann, London. Improvements in the manufacture of decorated glass-ware. December 31

1886.

297 W. Boulton and J. Davenport, London. An improved method and means of neutralising the oils used in colour printing earthen or china-ware. January 7
 801 J. Scott, South Sunderland. An improved and cheaper method in the manufacturing of rough plate glass by steam power, and improvement in kiln. January 19
 805 W. Jakes and W. J. Kershaw, Birmingham. Improvements in the ornamentation of glass articles and sheet or plate glass. Complete specification. January 19
 855 J. Wildigg, Hanley. The ornamenting of pottery and porcelain by a new method of applying "runners." January 20
 892 W. de Morgan, London. Improvements in means for transferring designs to articles of pottery ware. January 29
 965 A. Wilkinson, London. Improved methods of operating upon glass for producing ornamental or other effects. January 21

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

2310 J. Northwood. Decorating in various designs threaded glass articles in course of manufacture. December 29

8585 W. W. Boulton. Manufacture of glass or glass articles decorated with stripes. December 25
 14628 W. H. Hales. Machinery for moulding pottery-ware. January 8

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

1885.

15751 W. Joy, London. Improvements in the method of charging cement kilns. December 22
 15760 J. Longden, Sheffield. Improvements in ganister cement. December 22

1886.

31 W. Joy, London. Improvements in the utilisation of the waste heat from cement kilns and lime kilns. January 1
 116 J. Ferguson, Carlisle. Improved material for fire-proofing internal surfaces of buildings. January 5
 117 H. Peters, London. Improvements in the manufacture of Portland cement. January 11
 517 J. Bidwell and A. Bidwell, London. An improved cement or composition for various purposes. January 13
 809 J. Hadfield and J. Trippett, Sheffield. Improvements in treating and finishing the surfaces of asphalt, concrete and cement, when employed for floors, roads, pathways, and the like purposes; and apparatus and appliances for carrying the same into effect. January 19
 847 N. Snyer, London—Communicated by The Agalite Fibre Co., United States. Improvements in the preparation of plastic materials or compounds. January 19

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

1778 J. Tomlinson. Manufacture of plaster or cement. December 29
 2742 R. E. Goolden. Improved plastic compounds. January 19
 2775 W. J. A. Donald. Refractory materials and bricks, etc., suitable for lining furnaces and converters. December 29
 3916 E. Ormerod and W. C. Horne. Rendering cements luminous and damp-proof. January 12
 5187 A. W. Lake—Communicated by T. Hyatt. Improvements in illuminating tiles, and constructions made therefrom. December 29
 5188 A. W. Lake—Communicated by T. Hyatt. Improvements in illuminating combination tiles. December 29
 13639 W. Keller. Manufacture of cement or mortar. Jan. 1
 14061 H. Mathey. Manufacture of cement and lime. Jan. 15

X.—METALLURGY, MINING, Etc.

APPLICATIONS.

1885.

15901 J. R. Turnock, Loughor, S. Wales. Multiplex tin-plates, terne-plates, and other coated sheets. December 28
 15555 A. M. Clark—Communicated by H. Hannett, France. Improvements in purifying metals. December 18
 15813 E. G. Colton, London—Communicated by A. F. Wendt, New York. Improved process and apparatus for treating "flux-skunnings," resulting from the process of galvanising. December 23
 15814 M. Vesenmayer, London. Improvements in the method of collecting finely-divided gold and float gold, and in apparatus therefor. December 23
 15988 W. Elmore, A. S. Elmore, and H. Barrett, London. Improvements in the means of, and apparatus for the extraction of metals from their ores, particularly in the treatment of "blue-stone," and similar complex ores; and for electrolytically refining copper, and for the manufacture of sulphuric acid by electrolytic action. December 29
 16036 J. N. Longden, London. Construction of furnaces for treatment of ores and metals. December 30

1886.

27 F. A. Herbertz, London. Improvements in cupola smelting furnaces. January 1
 123 A. Montupet, London. Improvements in cupola furnaces. January 1
 159 J. E. Bennett, London. Improvements in the treatment of metallic chlorides for the production and extraction of metallic bases. January 5
 219 M. P. Hayes, London. Improvements in the casting of steel, and in moulds and apparatus connected therewith. January 6
 434 A. J. Maskrey and W. Jones, Glasgow. Improvements in or relating to the process of tinning plates and manufactured articles. January 11
 482 W. W. Popplewell, London—Communicated by A. F. Wendt, United States. Improvements in the method of, and apparatus for, separating and purifying metals and alloys of metals. January 12
 566 R. Hadfield, London. Improvements in the production and treatment of steel. January 13
 612 A. R. Sawyer, Stoke-on-Trent. An improvement in the mode of blasting or rending coal, ironstone, rock, and other mineral substances. January 15

618 T. Archer, jun., London. An improved implement for coal hewing and mining purposes. January 15
 939 J. Howie, Glasgow. An improved process for disintegrating or pulverising auriferous, stanniferous, and other ores. January 21
 918 A. Bobrownicki, London. Improvements in the treatment of phosphoretic slag. January 21

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

1360 T. V. Hughes and F. W. Harbord. Manufacture of basic plug-bottoms and bricks for the interior of Bessemer converters. December 22
 2835 J. C. Ridley. Pots for melting and desilverising lead. January 8
 3923 H. Wiggin, H. A. Wiggin, A. S. Johnstone, and W. W. Wiggin. Manufacture of nickel and cobalt. January 15
 3271 A. Davy. Apparatus for making steel by the Bessemer process. January 1
 6596 A. Davy. Apparatus for making steel by the Bessemer process. January 1
 6729 W. P. Thompson—Communicated by A. Kurzwehnart and E. Bertrand. Casting iron or steel ingots. December 29
 8039 H. Bain. Tinning and finishing tin andterne plates, and machinery therefor. January 12
 11921 W. P. Thompson—Communicated by C. Huscagvel. Producing malleable iron or steel direct from the ore, and apparatus therefor. January 5

XI.—FATS, OILS, AND SOAP MANUFACTURE

APPLICATIONS.

1885.

16033 J. L. Sabunje, London. Improvement in the manufacture of medical soap and tonic for hair-washing. December 30

1886.

125 T. Goodman, London—Communicated by A. Vignat and V. Capoul, France. Improvements in the manufacture of tallow for industrial and alimentary purposes. January 4
 326 C. D. Abel, London—Communicated by The Fabrik Chemischer Produkte Actien Gesellschaft, Germany. Method for the preparation of lanolin and anhydrous lanolin from the waste liquors of wool-washing establishments, and from commercial wool fat. January 8
 419 J. Y. Johnson, London—Communicated by C. L. Baillard, France. Improvements in the preparation or treatment of oils for use in treating wool, in the manufacture of soap and lubricants as mordants for dyeing, and for analogous uses. January 11
 510 A. Brunstein, London. Improved method and apparatus for obtaining alizarin oil from oleaginous seeds. January 12

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

2990 E. Green and E. Needham. Washing and cleansing fluid. January 15
 4090 G. Payne. Refining glycerine. January 15
 6667 J. H. Ashwell. Treating or utilising soap suds. December 22

XII.—PAINTS, VARNISHES, AND RESINS.

APPLICATIONS.

1885.

15752 P. Lawson, Glasgow. A new or improved anti-corrosive and anti-fouling enamel paint. December 22

1886.

571 W. Hamilton, London. An improved metallic compound or composition for the preservation or protection of ships, structures, and surfaces generally. January 13

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

12891 A. W. Anderson. Apparatus for facilitating the dissolution of oxide of lead and other substances for making lead salts for the manufacture of white lead, etc. January 8
 15171 C. D. Abel—Communicated by E. Schaal. Manufacture of turpentine from the resins of conifers. January 19

XIII.—TANNING, LEATHER, GLUE AND SIZE.

APPLICATIONS.

1885.

15565 W. P. Thompson, Liverpool—Communicated by G. E. Muth, Germany. Improvements in the preparation of soluble casein-albumenates, and in the application of the same for sizing, finishing, or varnishing paper, textile fabrics, wood, metal, and the like. December 18

1886.

938 J. L. Wade, Glasgow. Improvements in size for stiffening and finishing textile fabrics, yarns, and threads. Jan. 21

XV.—SUGAR, STARCHES, GUMS, Etc.

APPLICATIONS.

1885.

15828 S. M. Lille, Philadelphia, U.S. Improvements in process and apparatus for drying bone-black. Complete specification. December 23
 15897 M. P. W. Boulton, B. E. R. Newlands, and E. Perrett, London. A process for revivifying spent charcoal. Dec. 21
 15985 A. W. G. Adey, London. Improvements in the treatment of indiarubber waste. December 29
 16053 J. Schwartz, jun., London. Improvements in the manufacture of sugar. December 31

1886.

508 W. R. Lake, London—Communicated by W. T. Jebb, United States. Improvements in the manufacture of starch. Complete specification. January 12
 951 M. Mackay, London. The manufacture of a new material to be used as a substitute for gutta-percha and ebonite. January 21

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

1540 G. Fletcher and W. P. Abell. Centrifugal machines for drying sugar, etc. December 22
 1541 G. Fletcher. Centrifugal machines. January 8
 1542 G. Fletcher. Sugar-cane mills. December 22
 2738 G. Buchanan. Machinery or apparatus for treating sugar-cane. December 25
 7745 C. W. Guy. Sugar-cane crushing mills. January 22

XVI.—BREWING, WINES, SPIRITS, Etc.

APPLICATIONS.

1885.

15598 H. J. Worssam, London. Strainer-plates for hop-backs and mash-tuns for breweries. December 18

1886.

783 J. A. F. Bang and M. C. A. Ruffin, Paris. An improved process and apparatus for the purification of alcohol. Jan. 18

COMPLETE SPECIFICATION ACCEPTED.

1885.

5833 A. Boake and F. G. A. Roberts. Improvements in brewing. January 12

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

APPLICATIONS.

1885.

(A) *CHEMISTRY OF FOODS.*

15599 V. Tribuillet and E. Husson, London. Improvements in the preservation of alimentary substances, and in apparatus therefor. Dec. 18
 15721 A. F. Besnier and F. L. Corbiere, London. An improved manufacture of chocolate. December 21

(B) *SANITARY CHEMISTRY.*

15864 F. R. Conder, London. Improvements in the use and application of iron compounds, such as sulphate of iron, for the purification of water, and for other sanitary and curative purposes. December 24
 15895 C. D. Abel, London—Communicated by M. M. Rotten, Germany. Improved apparatus for purifying the effluent waters or liquids from factories, sewers, and the like. Dec. 24
 16060 J. H. Kidd, Wrexham. The complete purification of sewage from organic matter. December 31

(C) *DISINFECTANTS.*

15868 F. Candy and N. Frere, London. An improved closet-pan disinfectant. December 21

1886.

(B) *SANITARY CHEMISTRY.*

10 V. L. E. Miller, London. The drying of sewage, Jan. 1
 520 J. C. Bothams, Fisherton Anger, Wilts. Improvements in the arrangement and construction of apparatus for extracting sewage, sludge, or other semi-solid matter from tanks or places where it subsides or is precipitated. Jan. 13

572 E. R. Hordley, London. Improved Method of treating solid sewage matter, and the production of a substance therefrom suitable for manure. Jan. 13
 900 A. G. Salamon, London. Improvements in the purification of water and other fluids. January 29

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

(A) CHEMISTRY OF FOODS.

11233 J. E. Taylor—Communicated by W. Peacock. Preservation of fruit. December 22

(B) SANITARY CHEMISTRY.

2352 J. G. Lorrain. Filtration and purification of fluids, and oxidation of matters suspended or dissolved therein. Dec. 22
 2728 C. Price and H. Cleave. Filtration of sewage and apparatus therefor. January 12
 2885 W. P. B. Mainwaring and J. Edmunds. Purification of sewage and water containing organic matter. December 29

(C)—DISINFECTANTS.

11391 H. Endeman. Disinfectant and cleaning liquid. December 25

XVIII.—ELECTRO-CHEMISTRY.

APPLICATIONS.

1885.

15714 A. R. Upward and C. Pridham, London. Improvements in galvanic batteries. December 21
 15956 W. S. Whitter, Bristol. Improvements in electric batteries, and apparatus connected therewith. December 29

1886.

251 S. Vyle, London. An improved method of generating electricity. January 6
 321 G. J. Atkins, London. A new or improved electric battery. January 8
 398 J. T. Armstrong, London. Improvements in the method of supplying liquids and mixtures to electrical batteries. January 9
 615 W. Grierson, Glasgow. Improvements in dynamo-electric machines. January 11
 621 F. H. Varley, and The Varley Electric Patents Proprietary, Limited, London. Improvements in galvanic batteries. January 11
 771 H. Edmunds and W. T. Goolden, London. Improvements in apparatus for generating or utilising electricity. January 18

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

2776 W. H. Allen, R. Wright, and G. Kapp. Improvements in dynamo-electric machines, magneto-electric machines, and electric motors. January 22
 3019 J. J. Coleman. Construction and working of galvanic batteries. December 22
 3888 L. P. Merriam. Manufacture of electrical batteries. January 15
 3256 A. R. Bennett. Improvements in voltaic batteries. January 22
 8027 W. H. Tasker and T. J. Jones. Improvements in galvanic batteries, and in the electrodes of electrolytic converting tanks or troughs. January 18
 13151 E. G. Colton—Communicated by F. Haenichen, O. Haenichen, and O. Seebass. Neutralising the residual magnetism in electro-magnets. December 22

XIX.—PAPER, PASTEBOARD, Etc.

APPLICATIONS.

1886.

836 W. S. Hodgkinson and F. Lee, London. An improved paper suitable for bank notes, cheques, and the like. January 19

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

4569 A. McDougall. Boilers for conversion of woody or other fibres into pulp for the manufacture of paper, etc. January 22
 9602 L. A. Groth—Communicated by F. Kurtz. Pulping or rag engine, used in the manufacture of paper. January 8

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

APPLICATIONS.

1886.

596 C. Fahlberg and A. List, London. New compounds of organic alkaloids and saccharine, and method of producing the same. January 14
 629 T. Gladysz, London. Improvements in the manufacture of tartaric acid. January 11

XXI.—EXPLOSIVES, MATCHES, Etc.

APPLICATIONS.

1885.

15691 The Patent Oxonite Co., Limited, and R. Punshon, London. Improvements in safety blasting cartridges and detonators. Complete specification. December 21
 15635 S. H. Emmens, London. Improvements in projectiles for operations of war. December 21
 15636 S. H. Emmens, London. Improvements in smokeless gunpowders. December 21
 15637 S. H. Emmens, London. Improvements in the composition and manufacture of explosive substances. December 21
 15958 G. Bloem, London. An improved shell for fulminate and dynamite detonators, and for fulminating compounds in general. Complete specification. December 29

1886.

112 H. A. Schlund and A. Martin, London. Improvements in percussion fuses. January 4
 758 W. D. Borland, London. Improvements in explosive substances, and absorbent materials therefor. January 18

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

3671 S. Russell. Electric cartridges, and electric primers therefor. January 22
 15089 A. M. Clark—Communicated by E. Turpin. A new explosive; processes of preparing and using the same; and shell charged therewith. January 15

XXII.—GENERAL ANALYTICAL CHEMISTRY.

APPLICATIONS.

1885.

15678 W. E. Heys, Manchester—Communicated by E. Becker, United States. Improvements in and relating to chemical or analytical balances. Complete specification. December 21

THE JOURNAL

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In lists of members and new members in the January issue, "G. H. Allibon's" name was written "G. H. Allison," in error.

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MEETINGS, SESSION 1885-86.—First Monday in each month (unless otherwise indicated).

ORDINARY MEETINGS.

First Monday in the Month, at 8 p.m.

March 1.—Mr. Boverton Redwood, F.I.C.—“Viscosimetry.”
March 15.—Mr. T. B. Lightfoot, M.I.C.E., M.I.M.E.—“Ice Making—and Cooling Machinery;” and the Discussion on Mr. J. W. Westmoreland's Paper, which appears below.

April 5.—Professor Unwin, M.I.C.E.—“The Principles and Methods of Testing Cementing Materials.” This meeting will be held in the Central Institute, City and Guilds of London Institute, Exhibition Road, South Kensington.

May 3.—Mr. A. G. Salamon—“Purification of Water,” Messrs. Macnab and Beckett—“The Treatment of Water for Technical Purposes.”

June 7.—Dr. Meymott Tidy—“Chemical Treatment of Sewage.”

July.—Annual Meeting at Liverpool.
Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held Monday, February 1, 1886.

MR. D. HOWARD IN THE CHAIR.

THE DETERMINATION AND VALUATION OF COPPER IN ORES AND PRODUCTS FOR COMMERCIAL PURPOSES, WITH SOME REMARKS ON THE ASSAY OF GOLD IN BAR COPPER.

BY JAMES W. WESTMORELAND, F.I.C.,

Associate of the Royal School of Mines, London; Metallurgical Chemist, and Assayer, Leeds.

ALTHOUGH many members of the Society of Chemical Industry are engaged in the smelting and refining of copper from furnace material, and also in the extraction of copper from the burnt cinders of cupreous pyrites which have been used in the manufacture of sulphuric acid; and, although the smelting of copper and the manufacture of alkali are frequently conducted by the same firms in contiguous works, with the exception of a few remarks made in the discussions on “Uniform Methods of Analysis,” regarding the inaccuracy of the Cornish method of assaying copper ores (*Journ. Soc. Chem. Ind.*, 1884), and a paper by Dr. Watson, “On the Influence of Some Constituents on the Specific Gravity of Commercial Copper” (*Journ. Soc. Chem. Ind.* 1883, p. 153), no communications regarding the processes used in copper smelting in England, or on the methods used for the determination and valuation of copper have been made to the Society, and on referring to scientific and technical journals, the same lack of information is apparent.

Having been engaged for some years in the examination of copper ores, and being cognisant of the serious discrepancies in the analyses and assays which frequently occur, it seemed to the writer that a paper

on the subject would be of interest to the members generally.

Although for commercial purposes the valuation of copper ores, mattes, precipitates, and bar coppers (with the exception of refined copper where it is now generally stipulated that not less than 99.50 per cent. of pure copper by wet assay shall be present) is deduced from the results obtained by the Cornish process of dry assay; yet it is well known that almost every sample submitted to the dry assayers is examined by the wet assay, either by operators employed by the works buying or selling copper material, or by practising analysts on their behalf, and that the results so obtained have a distinct influence on the results or "settled produces" returned by the dry assayers.

The writer proposes to detail and criticise shortly: The processes used in the estimation of moisture, the estimation of copper by wet assay, the dry assay of copper, to compare the results obtained by the two processes, with suggestions for an improved method of assay, and also to consider the methods used for fixing the price to be paid for copper in pyrites, copper ores, etc.

THE ESTIMATION OF MOISTURE.

This, although apparently a simple process, is conducted very differently by various operators. In copper assay offices the samples are generally dried on sheets of paper placed on the iron plates surrounding the furnaces, and, in consequence, the temperature at which samples are dried varies considerably during the day; in the morning soon after the fires are lighted the temperature of the plates is low, while, after the fires have been in use some hours, the plates are hot enough to char paper easily, and, although this difference may not materially affect the percentage of copper in low produce ores, etc., it becomes more important when rich precipitates, containing 80 to 90 per cent. copper, are being examined.

PERCENTAGE OF MOISTURE LOST AT VARYING TEMPERATURES. AIR BATH.

	212° F.	250—260° F.	300—310° F.
Burnt ore . . .	1.50 . . .	1.53 . . .	1.60 . . .
" . . .	.55 . . .	.85 . . .	1.00 . . .
Precipitate . . .	.46 . . .	.51 . . .	.52 . . .
" . . .	.76 . . .	.91 . . .	1.07 . . .

The writer was present some time ago at a sampling of copper ore, and rich English precipitates, when the sampling was admirably conducted, but the moisture was determined in the following most objectionable manner.

1lb. avoirdupois was weighed, and placed in a thin shallow circular pan about ten inches diameter, made of sheet copper, this was placed on a slow fire and gradually heated to dull redness, the sample being stirred occasionally, when the whole sample had been exposed to a dull red heat for about ten minutes, the pan was removed from the fire, and after cooling, the residue was removed and re-weighed, the loss being calculated as "moisture."

In treating chemically-made precipitate in this way, no doubt all the moisture was expelled, but much of the copper was converted into black oxide, while it is very probable that with pyrites and arsenical ores, sulphur and arsenic would be partially expelled, and the apparent percentage of moisture increased.

In some cases the determination is made by holding the drying-pan at a distance over an open fire, but in the writer's opinion it is desirable that the temperature and manner in which the moisture is to be taken should be more clearly defined than it is at present, for it is evident that in cases where the determination is made at the time of sampling, and the wet sealed samples are afterwards dried by the assayers, any

difference in the temperatures at which samples are dried will cause an apparent loss or gain in the amount of copper present in the parcel, resulting in pecuniary loss to either buyer or seller.

PROCESSES FOR THE WET ASSAY OF COPPER.

Although many processes for the estimation of copper are known, comparatively few have come into general use either by analysts in practice, or works chemists. Most of the latter use the well-known cyanide process; in some cases copper is precipitated as sulphide, and, after roasting in a muffle, is weighed as oxide; in a large copper works in South Wales, copper is precipitated with metallic iron, the spongy metal being converted into oxide by roasting in a muffle, and weighed as such. One or two analysts in this country use the iodide process (especially for the examination of refined copper), while occasionally the electro-deposition method, which is employed largely in the United States, is also used. I am informed that titration of ammoniacal copper solutions with standard solution of sulphide of sodium is the method occasionally employed by one analyst, while I am not aware that the processes, by precipitation as oxide with caustic alkali, ignition of cuprous sulphide mixed with sulphur in a current of hydrogen gas, or the precipitation by sulphocyanide of potassium and subsequent weighing as Cu_2S , are used by any analyst in the examination of samples for commercial purposes. The processes I personally employ in the examination of all copper ores and products are E. O. Brown's iodide process, and the electro-deposition method.

That more care is needed in the examination of copper products, will be evident, from the following results, which were obtained in two laboratories (not those of practising analysts) constantly engaged in this special work:—

Laboratory A.	Laboratory B.
3.25 . . .	3.00 . . .
3.25 . . .	3.10 . . .
3.38 . . .	3.29 . . .
3.49 . . .	3.26 . . .
3.35 . . .	3.28 . . .
3.71 . . .	3.49 . . .
3.51 . . .	3.60 . . .
3.20 . . .	3.10 . . .
3.17 . . .	3.07 . . .
3.27 . . .	3.20 . . .
3.21 . . .	3.24 . . .
3.40 . . .	3.23 . . .
3.02 . . .	2.90 . . .

and the following—

A.	B.
3.38 . . .	3.09 . . .
3.41 . . .	3.39 . . .
3.35 . . .	3.27 . . .
3.12 . . .	3.10 . . .
3.17 . . .	3.00 . . .

In each of these samples representing parcels of ore weighing from 200 to 350 tons a difference of one-eighth of 1 per cent. .125 per cent., in the percentage of copper, would cause the price to vary by 1s. 6d. per ton; or, taking the low average weight of 240 tons per parcel, a difference of £18 per parcel for every .125 per cent. difference in the copper assays.

Again, the following assays of burnt ores from copper extracting works show very serious differences.

Works Assays.	J. W. W.
Original Assays.	Re-assay.
9.35 . . .	8.26 . . .
9.26 . . .	8.70 . . .
10.44 . . .	— . . .
9.42 . . .	— . . .
9.11 . . .	8.88 . . .
8.65 . . .	8.30 . . .
10.25 . . .	— . . .
	8.56 . . .
	8.61 . . .
	8.85 . . .
	8.83 . . .
	11.01 . . .
	9.17 . . .
	8.86 . . .
	8.89 . . .
	8.41 . . .
	8.34 . . .
	12.10 . . .

VARIOUS PYRITES AND BURNT ORES.

<i>Vendors' Assays.</i>		<i>J. W. W.</i>
	2.88	3.08
	4.38	4.55
	4.40	4.61
	4.41	4.65
	4.46	—
Re-trial	4.38	—
"	4.28	4.28
	3.16	2.99
	4.34	4.40
	4.52	4.82
	4.54	4.75
	2.33	2.24
Buyers' Assays	2.63	2.46
	2.69	2.35
"	2.74	2.63
	3.36	3.40
	3.66	3.85
	3.69	3.85
	3.69	3.73
Vendors' Assay	3.16	2.97
		2.97

<i>Vendors'.</i>	<i>J. W. W.</i>
3.75	3.62
3.90	3.69

<i>Original.</i>	<i>Re-assay.</i>	<i>J. W. W.</i>
2.88	3.04	3.10
2.36	2.91	2.89
4.32	3.83	4.11

PRECIPITATES.

<i>Vendors'.</i>	<i>J. W. W.</i>
81.75	79.72
77.50	80.52
79.60	77.94
77.25	78.89
78.50	—
Re-assay	76.00
	73.97

CUPREOUS PYRITES.

<i>Works Assays.</i>	<i>J. W. W.</i>
8.02	8.70
8.88	9.14

Portions of the finely-powdered samples which had been tested by the works' chemist, were forwarded to me, and being examined by the iodide process gave the following results:—

8.82
9.01 per cent. Copper.

To the two following parcels I append the difference in value between the works' chemists and my own assays—

<i>Works Assay.</i>	<i>J. W. W.</i>	<i>Difference in Value of Parcel.</i>
7.86	8.42	£75 17s. 6d.
7.96	8.34	57 10s. 0d.

My results in the above list were obtained by the iodide process; the others, with the exception of the precipitate assays, by the cyanide process, the discrepancies being due, in my opinion, chiefly to careless work by the operators, but partly also by the difficulties inherent to the method employed. Thus, to obtain accurate results, it is well known that the solution must not contain silver, zinc, nickel, cobalt, or manganese, and that the proportions of free ammonia and ammoniacal salts must be the same as in the copper solution used for standardising. The cyanide of potassium solution also decreases in strength on keeping, and has to be frequently titrated with known amounts of copper.

The direct titration of solutions of copper ores, mattes, precipitates, &c., obtained by dissolving in acid, and adding excess of ammonia, is not now, I think, used by any analyst; but to my certain knowledge it was the process used five years ago in an assay office where large numbers of copper samples are regularly examined. The results obtained by it

were used to check the Cornish dry assays, and its accuracy was assumed from the fact that it is described by a well-known recent writer on metallurgy.

The modified cyanide process now used in copper extraction and alkali works is as follows, for poor cuprous pyrites, etc.:—

The finely-powdered ore, 100 grains (in some works a smaller amount is taken) is dissolved in nitric and hydrochloric acids, filtered from siliceous matter, and largely diluted with water. Sulphuretted hydrogen gas is now passed through the solution, and the precipitated CuS , PbS , Bi_2S_3 , As_2S_5 , etc., are collected on a filter, washed, dried, and roasted in a muffle. The roasted product is dissolved in nitric acid, the solution evaporated to dryness with excess of pure sulphuric acid, heated till sulphuric acid fumes are evolved, and allowed to cool, diluted with water, excess of ammonia added, the solution filtered, and the blue filtrate titrated with solution of potassium cyanide, the standardising of which is made with pure copper-foil, conducted in precisely the same manner and under the same conditions (weight of copper, amount of sulphuric acid, volume of ammonia, bulk of solution, manner of addition of the cyanide solution) as in examining copper ores. This process, if carefully conducted, should give accurate results, but very often the reverse is the case. Thus, in examining a sample of cuprous pyrites, the following results were obtained by four operators in different works' laboratories:—

3.07 . 3.16 . 3.21 . 3.27

My own single assay by the iodide process was 3.34 per cent. This result was not challenged, nor was I requested to repeat the assay; the difference in value on this parcel between the highest and lowest assay—3.34, 3.07, .27—say $\frac{1}{4}$ per cent., would be £39, a matter of some importance.

In the following cases, the results of operators obtained in different laboratories and my own results are more in accord:—

<i>A.</i>	<i>B.</i>	<i>J. W. W.</i>
3.30	3.26	3.29
3.38	3.40	3.42
3.17	3.13	3.15
3.11	—	—
3.01	—	3.04
		3.03

The difficulties previously mentioned, alteration of strength of standard solution, necessity of having a similar amount of free ammonia and ammoniacal salts present, as in the copper solutions used for standardising, and the want of definition in the end reaction, in my opinion, make this process a very undesirable method of analysis; to the use of it, and the following process for the assay of copper precipitates, I attribute much of the annoyance, and occasionally pecuniary loss, caused by discrepancies in the results of different operators.

The following method is much used in copper extraction works for the estimation of copper in precipitates, and other products rich in copper:—20 grains of the dried precipitate is dissolved in pure nitric acid, and the solution is evaporated to dryness with excess of sulphuric acid. The residue is heated till sulphuric acid fumes are evolved; after cooling the mass is dissolved in water, filtered from the insoluble residue, and the filtrate precipitated by a current of SH_2 gas, the CuS collected on a filter, washed, dried, and the precipitate removed from the filter which is burnt. The precipitate with some pure sulphur is now added to the filter ash in a porcelain crucible, and ignited in a muffle till the weight remains constant. It is then dissolved in nitric acid, diluted, and excess of ammonia added; the

small precipitate formed is washed, dried, ignited, and its weight subtracted from the original weight of the calcined oxide which is then calculated to the percentage of metallic copper. My experience of this process is that it gives variable and high results, the following figures being obtained by an analyst who employs this method, and myself by the iodide process, on portions of the same finely divided sample. My results have since been confirmed by trials with the electro deposition method :—

Precipitation etc.

J. W. W.

78.65 . . . 77.63 Iodide and electro-deposition.

Works Assays two Operators at Different Works.

A.	B.	J. W. W.
80.8	79.2	79.48
81.0	79.9	80.28

The precipitation of copper as sulphide by SH_2 , followed by ignition of the dried sulphide mixed with sulphur in a current of hydrogen gas is recommended by Fresenius, *Journ. Chem. Soc.*, Abstracts, 1877, vol. ii. p. 650; and also by Burre, *Journ. Chem. Soc.* 1878, vol. ii. p. 337, for the estimation of copper in nickel and bronze coinage. In the latter paper it is shown that the current of hydrogen cannot be replaced by carbonic anhydride, as the results are then rather high. It is also stated that the results obtained by heating a mixture of sulphur and sulphide of copper in a covered crucible, removing the lid for a few seconds at intervals till the excess of sulphur has been volatilised, and weighing the resulting mixture of Cu_2S and CuO (containing theoretically 79.87 per cent. of metallic copper) gives no certain indication of the metallic copper present. My experience confirms this statement, and is the result of many hundreds of ignitions of mixtures of Cu_2S and sulphur, obtained by precipitating sulphuric acid solutions of copper with hyposulphite of soda; and the addition of carbonate of ammonia as recommended by the late David Forbes gives no better results. In my experiments, the ignitions were made over a good Bunsen burner, and my object in weighing the products was to get a rough idea of the percentage of copper present in the sample under trial. An objection to this process is made by A. G. Haddock (*Pharmaceutical Journal*, iii. 10, p. 801), who states that the mixture of Cu_2S and sulphur is very apt to boil over on heating, unless great care is taken in regulating the heat. I have, however, made several hundreds of these ignitions without experiencing the slightest difficulty. I am not aware that any English analyst uses either of these processes for the determination of copper in ores; and the fact that any bismuth present would be weighed with the sulphide of copper* is an objection to its use.

The method by precipitation as oxide by caustic potash or soda, after separating the copper from other metals, is recommended by A. G. Haddock, in the *Pharm. Journ.* previously quoted, as especially suitable for the determination of copper in cupreous pyrites and other ores, etc., containing but little of the metal.

The titration of ammoniacal copper solutions by standard solution of sulphide of sodium is, I believe, used by one analyst in this country; but the fact that

the sulphide solution rapidly decreases in strength, and requires standardising every time it is used, renders the process disadvantageous.

The methods of separating copper by precipitation with sulphocyanide of potassium or ammonium, and as metal by metallic zinc, are not, I believe, used by any analyst in the examination of commercial samples.

The following process is used at a large copper smelting works in South Wales.

The ore, matte, precipitate, etc., is dissolved in nitric acid, excess of sulphuric acid is added, and the solution evaporated till sulphuric acid fumes are evolved; after cooling, the residue is treated with water, and filtered. To the clear solution strong solution of sulphide of sodium is added in excess, but care is taken that the mixture has a distinct acid reaction. The precipitated sulphides are filtered off and washed, then treated with an alkaline solution of sodium sulphide to remove arsenic or antimony. The precipitate of CuS is now dissolved in nitric acid, sulphuric acid added, and the solution evaporated to expel the nitric acid, cooled, treated with water, and filtered. From the solution copper is precipitated by metallic iron, the precipitated metal washed, dried in a platinum crucible, and converted into oxide by roasting in a muffle; after weighing, it is dissolved in nitric acid, and excess of ammonia added; the small precipitate of oxide of iron formed is washed, dried, and ignited, its weight being deducted from the oxide of copper. I have not tried this process myself, but am informed that it gives satisfactory results when tested with a known weight of pure copper. The following results were obtained in examining a sample of copper matte by the above process at a copperworks, and by myself :—

Works chemist by iron precipitation method	66.92
Iodide process, J. W. W.	66.78

By the addition of solution of sodium hyposulphite to hot sulphuric acid solutions of copper, a flocculent precipitate of subsulphide of copper mixed with sulphur is obtained, which can be readily filtered and washed with boiling water; arsenic and antimony if present, are also precipitated; tin, iron, zinc, nickel, cobalt, and manganese are not precipitated. On igniting the precipitate the excess of sulphur, and most of the arsenic (if any is present) is expelled, an impure subsulphide of copper remaining. I have used this method extensively for separating copper from solutions of ores, mattes, precipitates, etc.; it dispenses with the use of sulphuretted hydrogen, which is in some localities an objectionable reagent.

The process described by E. O. Brown (*Quarterly Journal of the Chemical Society*, vol. x. p. 65, and which is also described in Dr. Percy's "Metallurgy of Copper") is based on the fact that when solutions of cupric salts are mixed with excess of iodide of potassium, subiodide of copper and free iodine are formed; and that this iodine can be titrated with a solution of hyposulphite of soda.

1000 grains of recrystallised hyposulphite of soda are dissolved in a Winchester of distilled water, and the solution is standardised by dissolving portions of electrotype copper, varying in weight from 6 to 8 grains, in nitric acid, boiling to expel nitrous fumes, and diluting with water. Solution of sodium carbonate is now added till a permanent precipitate forms, showing that all the free acid has been neutralised; and then acetic acid in excess. To this solution iodide of potassium in excess is added, and the flask or beaker shaken till it is dissolved. The solution of hyposulphite is now run in gradually from a burette, when most of the free iodine is removed, starch solution is added, and the titration

* Since writing the above, I have been informed that the method by igniting subsulphide of copper in a current of hydrogen gas is used in one copper extraction works, and in testing a sample of cupreous pyrites containing from 3 to 4 per cent. of copper by net assay, the results by this process, and my own by the iodide process, differed by .02 per cent. only.

finished in the usual manner. From the number of measures of hyposulphite solution used, the value of 1000 measures can be calculated.

In the original paper experiments are recorded, showing that dilution of the solution within wide limits had no effect on the reaction, and it is stated that no metals except lead and iron interfere—the former owing to yellow iodide of lead being formed, preventing the end reaction from being sharp, the red colour of ferric acetate also interferes, and I am also inclined to think that the ferric acetate liberates iodine from potassium iodide. No experiments are, however, recorded regarding the action of other metals, and it may be stated that in this and other papers generally on the estimation of copper, experiments made on weighed quantities of pure copper alone are given in proof of the accuracy of processes; and although this may be satisfactory for assays of refined coppers or chemical products, it is not so when minerals containing—besides copper—varying amounts of silver, arsenic, antimony, lead, bismuth, zinc, nickel, cobalt, manganese, iron, etc., have to be examined.

The writer has examined many hundreds of samples of all descriptions of copper ores and products by this process, and would recommend it as a most valuable method, far superior to processes previously described in this paper; and for copper ores and products (as distinguished from solutions of pure copper salts), it is, in his opinion, preferable even to the electro-deposition process.

For cupreous pyrites, burnt ores, etc., the following methods may be used: 50–100–150 grains are dissolved in acids, evaporated to dryness with excess of sulphuric acid, diluted with water and filtered. From this solution the copper is separated with hyposulphite of soda at Cu_2S , the precipitate dried, ignited, dissolved in nitric acid, evaporated with sulphuric acid to separate traces of lead, diluted with water and filtered, sodium carbonate added in excess, and then acetic acid to acid reaction. Potassium iodide is now added, and the titration conducted as in standardising.

As an alternative method the ore may be calcined, dissolved in hydrochloric acid, the ferric salt reduced by boiling with solution of sodium sulphite, and then passing SH_2 gas through the cold solution. The precipitated sulphides are washed, dissolved in nitric acid, and the process conducted as before.

Richer copper ores, mattes, precipitates, etc., are dissolved in appropriate solvents, the weight taken, and is generally such that from 7 to 9 grains of metallic copper is present. The solutions are precipitated either with hyposulphite of soda or sulphuretted hydrogen gas, the sulphides being dissolved in acids, and treated as before.

To satisfy myself regarding the accuracy of this process, I made many experiments, using known weights of pure electrolytic copper, silver, arsenic, antimony, lead, cadmium, bismuth, tin, manganese, zinc, and iron salts. The solutions were made to represent cupreous burnt ores, mattes, cupriferrous lead regulus, second quality, and rich precipitates, etc. Experiments were also made in many cases with the metals separately.

Taken.	Found.
5.068 Cu	5.069 Cu
5.011 Ag	
5.031 Cu	5.021 Cu
1.013 Zn	
1.072 Cd	
5.031 Cu	5.035 Cu
1.065 Zn	
5.176 Cu	5.164 Cu
1.05 As	
5.056 Cu	5.052 Cu
1.064 As	

Taken.	Found.	Taken.	Found.
5.053 Cu	5.011 Cu	5.078 Cu	5.072
1.20 gr.		1.20 gr.	
Tri-Nitrate Bismuth.		Tri-Nitrate Bismuth.	
5.208 Cu	5.208		
4.46 grs. crys. Manganous Sulphate.			
5.235 Cu	5.214 Cu		
1.05 Su			
5.014 Cu	5.021		
1.01 Su			

In these experiments, with the exception of the two last, the metals were dissolved in dilute nitric acid, boiled to expel nitrous fumes, excess of sodium carbonate added, then acetic acid to acid reaction, and the titrations made as before. In the two experiments with tin, the metals were treated with nitric acid, evaporated with sulphuric acid, diluted with water, filtered, and the filtrates treated as before.

The following experiments of mixtures represent various classes of products which are constantly being assayed:—

CUPREOUS PYRITES AND BURNT ORES=50 GRAINS.

Iron	.	.	.	31½ Grains.
(Sulphate to)	.	.	.	
Zinc	.	.	.	1.058 Cuprous sulphide,
				3.01 grs. = to
				2.401 Cu.
Tri-Nitrate Bismuth	.	.	.	.30
Lead	.	.	.	1.028 By standard solu-
				tion iodide proc-
				ess found 2.019
				grains copper.
Arsenic	.	.	.	1.021
Copper	.	.	.	2.02 Grains.

CUPRIFEROUS LEAD REGULUS=25 GRAINS.

Lead	.	.	.	3.00 Grains	.	.	.	3.00
Antimony	.	.	.	2.00	"	.	.	2.03
Arsenic	.	.	.	2.00	"	.	.	2.00
Iron	.	.	.	2.00	"	.	.	2.00
Copper	.	.	.	5.013 { Zinc	.	.	.	1.00
				5.003 { Copper	.	.	.	5.016
Copper found	.	.	.	5.003	Copper found	.	.	5.004
Cuprous sulphide (b) weighed—	.	.	.					
7.66 Grains.	.	.	.		8.69 Grains.			
Equal to—	.	.	.					
6.093 Grains Cu	.	.	.		6.910 Grains Cu.			

SECONDS PRECIPITATES=20 GRAINS.

Lead	.	.	.	.82	.80	.82
Tin	.	.	.	.40	.40	.40
Arsenic	.	.	.	.62	.61	.60
Bismuth	.	.	.	.40	.40	.40
Iron	.	.	.	8.00	8.00	8.00
Zinc	.	.	.	.40	.36	.40
Copper	.	.	.	8.072	8.143	8.044
Copper found	.	.	.	8.013	8.123	8.049
Sulphides weighed	.	.	.	10.71	10.39	10.69
Equal to metallic copper	.	.	.	8.578	8.777	8.538

RICH PRECIPITATES=10 GRAINS.

	Iron, .42	Arsenic, .103	Lead, .23	Zinc, .23
(a)	Copper taken	.	.	8.3105
	Found	.	.	8.315
	Sulphides weighed	.	.	10.32=8.402 Cu.
	Iron, .44	Arsenic, .255	Lead, .24	Zinc, .25
(b)	Copper taken	.	.	8.551
	Found	.	.	8.545
	Sulphides weighed	.	.	10.355=8.750 Cu.

A solution was made up containing—

Copper	.	43.282	! = 8.656 Grains Cu approximately equal to 10 grains copper precipitate.
Arsenic	.	1.01	
Lead	.	1.01	
Zinc	.	1.00	
Iron	.	3.00	

Two portions of $\frac{1}{2}$ each gave—

Copper found	8'656	8'650
Sulphides weighed : . .	10'925	10'92
Equal to metallic copper .	8'725	8'721
Iron	3'08 Grains.	
Copper taken	8'015	
Copper found	8'021	
Sulphide weighed	10'115=8'318 Cu.	
Copper taken	5'069 Grains.	
Copper found	5'063	
Zinc	5'085	

dissolved in nitric acid, evaporated to dryness with sulphuric acid, filtered, etc., excess of sodium carbonate and acetic acid added, and the titration made as usual.

In the experiments of mixtures representing burnt ores, precipitates, etc., the solutions of the metals were mixed, evaporated to dryness with sulphuric acid, diluted with water, filtered, the hot solution precipitated with hyposulphite of soda, the precipitate washed, dried, ignited and weighed. The impure Cu_2S was dissolved in nitric acid and treated as previously described.

Some time ago, experiments were made by the writer to see if the prejudicial action of ferric salts could not be eliminated, so that the process could be used to examine copper precipitates containing from 60 to 90 per cent. of metallic copper without previously separating the iron. For this purpose solutions of arsenic acid and phosphate of soda were added to the copper solutions previous to the addition of sodium carbonate and acetic acid, arseniate and phosphate of iron were precipitated, and the iodine reaction was not affected. When phosphate of soda solution was added to copper solutions, no change occurred in the amount found on titration, or when small amounts of iron were present; with more iron the large amount of precipitated phosphate or arseniate of iron seemed to interfere, representing in a 60–70 per cent. precipitate, about 40 per cent. in the amount of copper present.

Taken.	Found.
5'232grs. Cu. 12grs. crys. Phosphate of Soda	5'219 Cu.
5'263grs. Cu. 12grs. crys. Phosphate of Soda	5'264 Cu.
5'164grs. Cu. 12grs. crys. Phosphate of Soda	5'158 Cu.
8'675grs. Cu. 505 Fe.	End reaction not distinct, but 8'797grs. Cu found.
8'672grs. Cu. 505 Fe. 15grs. Phosphate of Soda	8'677 Cu.
8'665grs. Cu. 515 Fe. 15grs. Phosphate of Soda	8'663 Cu.
8'672grs. Cu. 2'00 Fe. 20grs. crys. Phosphate of Soda	8'607

In the following experiment the copper, arsenious acid and iron were dissolved in nitric acid, well boiled, the solution diluted, excess of sodium carbonate and acetic acid added, and the titration made as usual—

7'99grs. Cu taken 1'81 Fe As ₂ O ₃ 4'00grs.	7'953 Cu found.
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Two other experiments with phosphate of soda and ferric salts were as follows—

8'681 Cu taken 2'27 Fe 20grs. crys. Phosphate of Soda	8'611 Cu found
8'759 Cu taken 1'95 Fe 15grs. crys. Phosphate of Soda	8'729 Cu found

An objection to this process has been made by certain copper extraction works; and supported by a well-known metallurgical chemist. It is stated that arsenic present as arsenic acid in solutions of copper separated in the ordinary course of analysis from cupreous pyrites, in an acetic acid solution liberates iodine from solution of potassium iodide, and that this iodine measured in the usual way by standard hyposulphite, caused the copper assays to be above the true percentage. This objection was strenuously urged some three years ago by buyers of cupreous pyrites, and letters detailing experiments made in refutation were written by me, and were copied and forwarded by my then employers to the buyers concerned.

In the following experiments, portions of electrotype copper and metallic arsenic were dissolved in nitric acid, the solutions boiled well and evaporated to a small bulk, diluted, an excess of sodium carbonate solution and acetic acid added, and the titrations made as usual.

2'021grs. Copper taken 2'00 Metallic Arsenic	2'019 Cu found
4'121grs. Copper taken 4'018 Metallic Arsenic	4'109 Cu found
2'065grs. Copper taken 20'2 grs. Arseniate of Soda	2'066 Cu found

21'1grs. of arseniate of soda were treated with strong nitric acid, the excess being removed by evaporation; sodium carbonate being then added in excess and the solution acidified with acetic acid, and 30grs. crystals potassium iodide added. After standing 25 minutes, traces only of iodine were liberated.

2grs. metallic arsenic were dissolved in excess of nitric acid, and evaporated to a small bulk, then sodium carbonate added in excess, and the solution acidified with acetic acid, 30grs. crystals of potassium iodide were added, after standing 25 minutes, traces only of iodine were liberated.

30grs. of potassium iodide, water and acetic acid were mixed, traces only of iodine were liberated after standing one hour.

I regret that more recently this objection (the interference of arsenic) was apparently confirmed by the following "doubtful" assays which were supplied to copper extraction works. It is usual for works buying cupreous pyrites to send their wet assays of parcels to the dry copper assayers who "settle" the produce, and it is understood that there must be a certain margin between the wet assay and the "settled produce," for example in pyrites containing 3'00 per cent. of copper by accurate wet assay, the settled produce will be about 2 $\frac{1}{8}$ per cent., no buyer would care to give 2 $\frac{1}{8}$, but formerly it might have been settled at 2 per cent., or even lower. In these samples some difficulty occurred, the copper assayer was requested to send his wet assays and afterwards portions of the samples his chemist had operated on to be tested at the buyers' works. The results obtained confirmed their original wet assays, and a letter was received stating that the results showed most clearly that the objection previously taken to the iodide process was a valid one, and that it was seriously inaccurate for testing samples of cupreous pyrites.

The assays were as follow:—

Two Parcels.	A.	B.
Original works wet assays	3'26	3'12
Portions of samples assumed to have been operated on by iodine process by copper assayers' chemist; tests made at copper extraction works	3'25	3'08
"Doubtful" results assumed to have been made by iodide process and sent to the copper extraction works	3'38	3'31

I have examined my note-books carefully, and cannot find any record of the examination of these samples. All parcels I examined are numbered consecutively, and there are none missing; moreover I was not informed that such a serious blunder had occurred. I am therefore compelled, however much I may regret doing so, to assert that the results 3.38 and 3.34 per cent. are "doubtful" assays, and are not of the slightest value in determining the reliability or otherwise of the iodide process.

The method described as De Haen's process in "Fresenius' Quantitative Analysis," 6th edition, p. 230, is a modification,—to a neutral solution of copper, or a solution moderately acidified with sulphuric acid, potassium iodide is added, and the liberated iodine titrated as usual. Bayley, in a paper on the analysis of copper, zinc, and nickel alloys (*Philosophical Magazine*, (5) 6, p. 14; and *Journal of the Chemical Society*, 1879 (2), p. 485), uses the same process, dissolving the alloy in nitric acid, then expelling it by evaporation to dryness with sulphuric acid; after cooling, the sulphates are dissolved in water, potassium iodide added, and the liberated iodine titrated as usual. An objection to this modified process is that iodine is more readily liberated from solutions of iodide of potassium mixed with sulphuric acid than with acetic acid, and there can also be no doubt that if arsenic acid is present, iodine will be liberated and calculated as copper. To the neglect of this fact, and disregarding that all my titrations were made in acetic acid solutions, I attribute the doubts expressed by some chemists as to the accuracy of E. O. Brown's process.

The method by precipitation with metallic iron, and weighing the spongy precipitate of metallic copper, although used to some extent abroad, is not, I believe, used as a commercial method in this country.

The deposition of copper by the voltaic current has not become a standard method in this country, though it has been used by some operators, but it is largely used in the United States. The statements made by various writers with regard to its accuracy are very discordant.

Thus in a review of the pocket book for manufacturers of soda, potash, and ammonia (*Chemical News*, vol. 47, p. 140), it is stated on the authority of G. Lunge, "that the electrolytic method for the determination of copper in cupreous pyrites has not yet been adopted in copperworks, as it has not been found practicable to obtain the copper sufficiently pure by a single precipitation." He recommends the precipitation of copper as sulphide, with certain precautions; and the ignition of the precipitate mixed with sulphur in a current of hydrogen or coal gas.

A. G. Haddock, in his paper previously quoted, in speaking of the deposition of copper from sulphuric acid solutions by electrolysis, recommends the addition of a little nitric acid to the solution, and precipitation in a platinum dish. He states that much difficulty is experienced in precipitating the last traces of copper, and recommends that these traces should be precipitated with sulphuretted hydrogen, and weighed as Cu_2S , the amount of metallic copper so obtained being added to that directly obtained by electrolysis. He advocates its use as one of the few reliable methods for the separation of copper and zinc, and states that two small Bunsen elements give sufficient current. Contrary to the experience of Luckow, who has also described a modification of this process (see "Crooke's Select Methods of Chemical Analysis, or Quantitative Analysis," T. E. Thorpe, p. 209), he states that arsenic interferes, depositing on the copper towards the end of the deposition.

In the *Chemical News*, vol. xlv, p. 279, a paper is published by J. B. Mackintosh, which had been read

before the American Institute of Mining Engineers, May, 1881, on the "Electro-deposition of Copper." He describes Luckow's method, and gives results by it, and also by electrolysing sulphuric acid solutions of pig copper and brass, showing that the electro-deposition method from solutions containing organic acids gave too high results. In the discussion following the reading of the paper, Mr. S. P. Sharples, of Boston, U.S., referred to some experiments made by himself, and also to those of Mr. E. V. McCauldless, made in 1864, and published in the *American Journal of Science and Art*, January, 1865, on the "Electro-deposition of Copper from a Sulphuric Acid Solution in a Platinum Dish." These experiments are of the same character as are generally published; pure electrolytic copper was dissolved in nitric acid, the solution evaporated to dryness with sulphuric acid, the residue dissolved in water and electrolysed. Almost any process will give good results with such a solution, but it is a very different matter when arsenic, antimony, bismuth, silver, or large amounts of ferric salts are present.

Mr. Sharples stated that a large excess of free acid, if present, must be neutralised with ammonia, but that a small amount of nitric acid is not prejudicial. He takes from two to five grammes of ore, etc., dissolves in nitric and sulphuric acids, heats to boiling, dilutes with water, and filters into a platinum dish, electrolysing the solution with the current from two Grove's cells, stating that if the dish is put in the circuit in the evening, the copper is generally completely precipitated the next morning. He remarks that the commercial allowance for errors is half of one per cent., but that duplicate assays rarely vary more than one-tenth of one (10) per cent.

My experience with this process, using the current from two large Daniell's cells, and precipitating the copper in a platinum dish, is that the process is not satisfactory in all cases; the results are accurate with pure solutions of copper acidified with sulphuric acid, but if silver or bismuth is present, they are deposited; and in one experiment tin was also deposited with the copper. In the presence of ferric sulphate the precipitation is delayed, while in a nitric acid solution rendered ammoniacal and acidified with sulphuric acid, a sensible amount of copper was left in solution. With refined or bar coppers and rich precipitates, eight or nine grains of copper may easily be precipitated during the night. Mattes, ores, cupreous pyrites, and burnt ores are rarely precipitated in one night, often requiring forty-eight, and sometimes seventy-two hours for complete precipitation, even after a double evaporation with sulphuric acid, to expel the nitric acid as completely as possible.

In the following experiments the deposited copper was well washed with water, the dish was then rinsed with alcohol, and dried in the air-bath at 212–220° F.

H_2SO_4 solution.	3.785grs. Cu taken.	3.771grs. Cu found.
Nitric acid solution, excess of ammonia added, and carefully acidified with sulphuric acid:—		
	3.892grs. Cu taken.	3.817grs. Cu found.
	3.823 " " "	3.782 " " "

Both the solutions from these experiments showed that the copper was not completely precipitated on addition of sulphuretted hydrogen solution.

H_2SO_4 solution.	3.733grs. Cu taken.	
	.914 " Ag	
	4.647 "	4.639grs. found.
Nitric acid solution rendered ammoniacal, and acidified with sulphuric acid:—		
	Copper ...	3.431grs.
	Silver.....	1.43 "
		4.861 "
H_2SO_4 solution.	Copper 4.151grs. taken.	4.131grs. Cu found.
	Arsenic .856 "	

In this experiment the metals were dissolved in nitric acid and the solution evaporated with sulphuric acid, the residue dissolved in water, and the solution electrolysed.

H₂SO₄ solution. Copper, 4.512grs. taken. Metal
Solution of carbonate of bismuth added, 4.776grs. deposited.

Copper taken, 8.856grs. Zn .255 As .215 Sn .21 Pb .11 Fe .45
 „ found, 8.906 „

Copper taken, 8.712grs. Zn .220 As .25 Sn .381 Pb .23 Fe .41
 „ found, 8.674 „

Copper taken, 8.833grs. Zn .26 As .21 Sn .32 Pb .30 Fe .40
 „ found, 8.828 „

Copper taken, 8.032grs. 8.009grs. found.
Iron " 3.01 " (as ferric sulphate.)

Copper taken, 5.231 grs. Zn 1.155 As₂ 2.00 Sb 2.035 Pb 3.00 Fe 2.02
 " found, 5.200 "

Copper taken, 5.289grs. Zn 1.01 As 2.035 Sb 1.985 Pb 2.96 Fe 2.05
 " found, 5.788

Copper taken, 2.044grs. Zn 1.00 As 1.10 Pb 1.30 Fe 31.52
 „ deposited after forty-eight hours, .819grs.

Copper taken, 2.186grs. Zn 1.07 As .99 Pb 1.02 Fe 31.56
 „ deposited after forty-eight hours, .946grs.

Total . 2172 "

Copper taken, 8.336grs. Zn .135 As .66 Pb .81 Sub-carbonate
of Bi .60 Iren .806 Sn .460
„ metal deposited, 8.816grs,

In all the above experiments the solutions of the metals or salts in nitric acid were mixed and evaporated to dryness with sulphuric acid, the residue dissolved in water, the solution filtered and electrolysed. In working this method of analysis recently, I have experienced difficulty in precipitating the last traces of copper, having had to leave the dish in the circuit for forty hours.

Bar Copper—results by iodide process—

Another sample, 95.12–95.17 per cent.

By the electro-deposition process—		
After eighteen hours	91·98	95·03
„ twenty-four hours longer	92·27	95·28
	<hr/>	<hr/>
Deduct silver	95·25	95·31
	16	16
	<hr/>	<hr/>
	95·09	95·15 per cent.

My experience is, that while the results with refined or bar coppers and rich precipitates agree well with those obtained by the iodide process, those obtained by electrolysing sulphuric acid solutions of mattes, copper ores, etc., are generally slightly below the true percentage.

With burnt ores, cupreous pyrites, and ores containing but little copper, I first precipitate with sulphuretted hydrogen, dissolving the sulphide in nitric acid, and evaporating this solution with excess of sulphuric acid, the sulphates dissolved in water give a solution from which copper (and bismuth) is readily deposited. The results by the battery process are generally from '01 to '04 per cent. higher than by the iodide process, this being caused by a slight deposit of bismuth.

In the following case, where much bismuth was present, the result by the battery process is considerably higher :—

Battery or electro-deposition process	5.39 per cent.
Iodide process, J. W. W.	5.09
Iodide process, another laboratory	5.12 "

The following results are examples of the agreement obtained in assays made by the electrodeposition and iodide methods, and are taken from a

large number obtained in the examination of parcels of ores for commercial purposes :—

Iodide Process, J. W. W. Battery Process, J. W. W.

Precipitates	. 77 68	77.67 + 77.71)
--------------	---------	--------------------

$$\left. \begin{array}{l} 86.78 \\ 86.82 \end{array} \right\} \begin{array}{l} 86.80 \\ 86.83 \end{array}$$

(73:32	73:33
(73:38	73:24)
(73:30	73:18)

Copper Mattes .	71'86	71'83
-----------------	-------	-------

63:24
63:20
63:30 by another
chemist.

44:43 44:37
(23:54)

Various Copper)	23.56	23.62
Various Copper)	10.154	10.156

ores, pyrites, etc.)	15.171	15.176
burnt ores, etc.)	30.91	30.82

139'91	39'95
139'96	

	2.33		2.33
50grs.	3.157		
60	3.175	100grs.	3.194

150	3.164	
	3.60	3.61

2.38	2.36
17.97	7.99
17.99	

3.89	3.89
2.478	2.49

2.56	2.59
3.31	3.35

0.01	0.03
3.25	3.27
5.24	5.1

3:34	3:4
3:55	3:59)

359
45 46

In all cases where mattes were examined, and with some copper ores, it was necessary to leave the dish in the circuit for two nights, in order to ensure complete precipitation.

Recently, I have been in correspondence with American analysts regarding this process, samples having been examined by the iodide process by me, and by their electro-deposition process, the results show that in three of the four samples examined their results were rather higher than mine. The results on the copper matte, however, are very concordant :--

AMERICAN COPPER ORES CONTAINING ARSENIC,
ETC.

American Electro-deposition results.	Iodide Process, J. W. W.	Cornish "Settled" Produce.	"Margin" be- tween Cornish Settled Pro- duce and Iodide Process Wet Assays.
28.25	$\left\{ \begin{array}{c} 28.15 \\ 28.09 \\ 28.16 \end{array} \right\}$	26 $\frac{1}{2}$	2.00
28.05	$\left\{ \begin{array}{c} 28.33 \\ 28.23 \end{array} \right\}$	26 $\frac{1}{2}$	2.15
27.87	$\left\{ \begin{array}{c} 27.73 \\ 27.62 \end{array} \right\}$	25 $\frac{3}{4}$	2.30
Copper Matte, 63.30	$\left\{ \begin{array}{c} 63.21 \\ 63.26 \end{array} \right\}$	61 $\frac{1}{2}$	1.93
Electro-deposition, J. W. W.	63.20	—	—

Large quantities of copper mattes and ores are bought in New York on results obtained by the electro-deposition method, and these parcels are sent

over here to be smelted and refined. Arriving in Liverpool, the ores and mattes are resampled, and assays are made by the Cornish assayers; serious discrepancies have occurred, causing much annoyance and loss to the importers and their agents in New York. In two cases it was said that the Cornish settled produces were thirteen and five per cent. respectively below the American assays, this was due in some measure to defective sampling, either here or in New York; but it was also admitted that the settled produces were lower than they should have been. My wet assays and the "settled produces" dry assays were as follows:—

<i>Wet Assays</i>		<i>Settled Produce</i>		
<i>Iodide Process.</i>		<i>Dry Assays.</i>		<i>Margin.</i>
<i>J. W. W.</i>				
48.09 48.16	48.12	45½		2.62
47.87 47.85	47.86	44½		3.24

Two per cent. on this material would be a fair margin between the wet and dry assays, and the loss to the vendors of these two parcels would be £11 5s. and £18 15s. for five-eighths per cent. and one and a quarter per cent. respectively.

THE CORNISH PROCESS OF "DRY ASSAY."

A detailed description of this process, which is not used for the valuation of copper ores and products in any other country but England, may be found in Dr. Percy's Metallurgy, volume, "Copper, Zinc, Brass," and also in Phillips' "Elements of Metallurgy." Its advocates claim that the percentage of copper obtained by it represents the amount which will be produced in the smelting operation, and that the assay button of fine copper will give a fair indication of the quality of the metal which will be obtained in smelting. How far the latter statement is correct will be shown presently.

Briefly, the process consists in separating the copper from the earthy constituents of the ore by a series of fusions in an air furnace—first into a matte or regulus containing, besides copper and sulphur, a certain amount of iron, and small quantities of other metals, then converting this regulus into a mixture of oxides of iron and copper by calcination; afterwards reducing the copper and a portion of the iron to the metallic state as "coarse copper," by fusion with tartar, borax, nitre, carbonate of soda, and salt, refining this coarse copper by oxidation, when in the molten state; the latter part of the refining process being conducted under a mixture of "refinery flux" and salt, a button of "refined copper" and refinery slag resulting, then running down the refinery and coarse copper slags with tartar, in order to obtain the last portions of copper in a prill, which is generally assumed to be half copper.

The first process or "fusion for regulus," is conducted differently by various operators. Thus, some assayers in operating on poor cupreous pyrites and burnt ores, run a "coarse regulus" (i.e., a regulus containing an excess of iron); this is afterwards "warmed" or slightly roasted, and again melted with fluxes to obtain a "good regulus." This method of procedure is said to give a higher result than if the sample is run down for a good regulus in the first instance. Arsenic, if present in any quantity, is always expelled by roasting before the sample is fused for regulus, and if necessary sulphur is added to replace that lost during the roasting.

The regulus is powdered and then calcined to expel the sulphur, a mixture of oxides of copper and iron remaining. If the calcination has been effected in a crucible, tartar, nitre, borax (sometimes a little sodium

carbonate) are added, and mixed with the oxides; salt is added to cover the mixture, the crucible placed in an air furnace, and fused for coarse copper. After pouring the melted contents of the crucible into an assay mould, it is replaced in the furnace, the button of coarse copper added, together with some refinery flux and salt, the metal being submitted to a preliminary refining or "washing." The "washed copper" is then refined, by oxidation, in the molten state, "refinery flux" being added when the operation is nearly completed. The refined copper is poured into an assay mould, the slag separated from it, and fused together with the slags from the coarse copper fusion and "washing," with a little tartar to obtain a "prill" of impure copper; this is generally assumed to be half copper, though in some cases, where it is heavy, as from rich precipitates and bar coppers, it is refined and weighed with the button of "fine" copper.

The standard weight of ore operated on is 400 grains, but for mattes, rich precipitates, bar coppers and copper material generally containing over 50%, 200 grains, or as it is generally termed, "half trial," is operated on.

Copper mattes are calcined direct, fused for coarse copper, washed and refined. Rich precipitates are fused for coarse copper, washed and refined, while bar coppers require washing and refining, or very pure samples refining only.

It is well known that the Cornish dry assay gives results always below the truth; in fact, contracts are made based on the assumption that with certain classes of material, cupreous pyrites, burnt ores, mattes, precipitates, etc., there will be a definite margin between the results of wet and dry assays; and when this margin from any cause is greater or less than usual, much dissatisfaction occurs, and sometimes serious pecuniary loss results. But it is not generally known that in many cases the produces obtained are very variable and almost unreliable. Thus, to obtain concordant results, it is absolutely necessary that the same weight of material should be operated on in exactly the same manner; and if any changes are made, the results will not be in accord. Even in operating on the same weight of material, many cases are known to me where 1% difference occurred in two assays of the same sample (70–90% produce), and in assays of copper mattes ½ to 1% discrepancies in assays by the same operator are of frequent occurrence. It would be impossible to obtain concordant results if different weights of ore, which can be safely used in wet assays, were employed. Thus, I have given results of wet assays where 50, 60, 100, 150 grains of ore were operated on by different processes, and the results were concordant; but if these "proportions" (not weight in grains) were employed in making four dry assays, I am afraid the results would be anything but satisfactory; and it is well known that when "half trial" and "whole trial" assays are made on the same sample, the results of the latter are always higher than the former.

Again, in the "fusion for coarse copper," the object of the assayer is to get *all* the copper, together with a little iron and small quantities of other metals, in the "coarse copper," for if it is brought down "too coarse," a greater loss occurs in refining. This fact was brought prominently before me by the following assays of a sample of copper precipitate:—

Wet assay iodide process, J.W.W.	87.7% Cu
Dry assays with refined prill	85½
Margin	2½

* Refinery flux.—A mixture of nitre, tartar, and some salt, which has been deflagrated in an iron pot, with a red-hot iron bar. The proportions are so adjusted that a slight excess of nitre remains which exerts an oxidising or refining action on the molten copper.

The margin between the two processes being higher than usual, on investigation it transpired that the copper in the first fusion was "too coarse," hence the loss; on a re-assay, 86% was easily obtained, the sample being settled at 85½.

Wet assay	87½
Dry re-assay	86
Settled produce	85½

Again, the process sometimes fails in the hands of men who have been making dry assays for years. Thus, a parcel of burnt ore (many samples of which were being tested at intervals) was assayed on behalf of the vendor, giving a produce of 2%, it was suspected that a higher percentage was really present, my wet assays on two separate samples being 3·10–3·12%; the buyers' assayer agreed to settle this parcel at 2½%, a fair produce, as ½% is the usual margin with this percentage of copper. A difference of ½% on this parcel—and it must be remembered that the vendor's assay was the lowest—would amount to £36 in money value.

Wet assay, burnt ore, J.W.W.	3·10–3·12%
Vendors' assayers' produce	2
Settled produce with buyers' assayer	2½
½ money value on parcel	£36

The following is a much more serious case of error, in which four of the most experienced copper assayers were concerned. Several parcels of copper material being sold, samples were sent to the copper assayers to be examined in the usual manner; the assayers could not agree on a produce, and the samples were referred to a third assayer. A sample was also examined by the iodide process of wet assay, by me. The results were as follow:—

Vendors' assayer referred on.	33½
(but asked 31% at first)	
Buyers' assayer, highest produce	32½
Referee's assays	33
Wet assay, iodide process, two separate samples J.W.W.	37·01

The results of the wet assay being much higher than those of the dry assays, further trials were made by the referee, by a modified process, when 35½ per cent. was obtained. The return made by the referee was 34½ per cent.

Referee's re-assays by modified process	35½
Referee's return as umpire to vendors' and buyers' assayers	34½

When the buyers' assayer received this produce he forwarded his own and the vendors' assayers' results, asking also if an error had not occurred; he stated, also, that another assayer, a well-known man with large experience, had given similar material, when acting as umpire, in favour of the buyer. On receiving the above return, the buyers, who are copper smelters, informed their assayer that the produce, 34½ per cent., was higher than their wet assay. The dry assays were made by four of the most experienced copper assayers, all well-known men; and the smelter's chemist should be able to make an accurate wet assay; but in my opinion the results are disgraceful to all the parties concerned. The parcel was only a small one, and as the assayers all obtained approximately the same produce in the first instance, it is evident that the samples were alike; while a modified process of assay, giving results 2½ per cent. higher, shows that the assayers did not know how to treat the sample, although they had been examining parcels of similar material for years. When the money value of the parcel is calculated from the results of the various assayers, the importance of the matter is still more evident. For obvious reasons I cannot record tonnage

and price per unit; but I have verified the latter by referring to the *Mining Journal*.

Value deduced from vendors' assay, 33½	£	s.	d.
Mean	618	8	6
Buyers' assay, 32½	611	1	9
Referee's first assays, 33	633	15	0
Referee's modified process; produce actually obtained, 35½	694	13	9
Referee's return, 34½	677	12	6
Difference in value between assays by buyers' assayer and referee's modified process	60	18	9
Difference in value between mean value by buyers' and sellers' assays and referee's return as umpire	36	10	9

The following results of assays of copper matte also reveal serious discrepancies. Several hundred tons of copper matte were imported, 470 tons were assayed and settled at 46½. Two parcels, each representing 100 tons matte, were assayed by other assayers, and settled at 48 per cent.

470 tons settled at	46½
200	48
Wet assays of the 200 tons gave by the iodide process, J.W.W.	49·29
	49·33

In the last two samples, representing 200 tons of matte, strong pressure had evidently been applied to the buying assayer; the margin is much lower than usual, and the buyers suffered. The results also show that serious errors often exist between assays made by different operators. If 48 per cent. was a fair produce for the parcel, a difference of 1½ per cent. on the 470 tons settled at 46½, at 10s. per unit, would amount to £293 15s.; while if 46½ per cent. was correct, the loss to the buyers on 200 tons, settled at 48 per cent., would amount to £125.

The extreme variation in the results of dry assays is also shown in the following assays; the referee and vendors' assayer were the same, but different men, both recognised copper assayers, acted for the buyers.

Vendors' Assayer's Results.	Buyers' Assayer's Results.	Referee's Return.
57½	57½	57
57½	56½	57
58	57	57
59½	58½	61½
59	58½	60½

Again, the presence of lead has a great influence on the results of copper assays by the Cornish method. If not present in too large a quantity, it seems to prevent loss of copper during the "refining," and gives a higher produce. Some time ago a precipitate, containing about 4 per cent. lead, and 70–85 per cent. of copper, was largely produced, and samples were sometimes settled with less than 1 per cent. margin between the wet and dry assays. Lead is not easily expelled in refining, and two buttons of "fine copper," said to be quite "fine" by experienced assayers, and which would be "burnt" if the refining was carried further, contained the following percentages of lead:—

FINE COPPER ASSAY BUTTONS, CORNISH DRY ASSAYS.

(a.) Metallic lead	2·21%
(b.) Metallic lead	1·78

I regret that my research in this direction came to an abrupt termination. I was unable to obtain more material for experiments.

The effect of lead on the results of dry copper assays is also shown in the following sample of copper precipitate:—

Wet assays, iodide, and electro deposition process, on two samples	77·63–77·68%
Buyers' assayer's results, dry assays	76·0–76·9
Settled produce	74½
Metallic lead present	1·01

A very good illustration of the confidence and reliance to be placed on results obtained by dry assay.

The presence of some amount of lead, however, has a very different influence, as it is impossible to expel it without serious loss of copper. With copper ores containing much lead, it enters the regulus, which is fusible and difficult to calcine; it also enters the "coarse copper" and causes excessive loss in refining; in fact it is impossible to obtain concordant results. A sample of cupriferous lead regulus gave the following results:—

Wet assay iodide process, J. W. W.	11.63%
Vendors' assayer's dry assays	10½–11½
Buyers' assayer's highest dry assay	11½
Settled produce	12

12½ per cent. was asked for this parcel by the vendors' assayer, whilst the buyers' highest assay was 11½; but, taking the wet assay, 11.63 per cent., into consideration, it was agreed that 12 per cent. should be the settled produce, although neither of the assayers could make that percentage.

The assays of this parcel also show that buyers and sellers may state in their contracts for the purchase and sale of copper ores, etc., that the samples shall be assayed by Cornish assayers in the usual manner—i.e., by Cornish dry assay; yet it by no means follows that this will be carried out; in fact numerous cases are known to me where the wet assays have had more influence in deciding the "settled produce" of a parcel than the results of the dry assays.

The effect of a small percentage of lead on the assays of copper mattes, ores, etc., is shown in the following assays:—

COPPER MATTE.

Vendors' assayer's dry assays	46½, 45½%
Settled produce	45½
Wet assays, J. W. W., iodide process	48.55, 48.14
Margin between wet and dry assays	3.00

COPPER ORE CONTAINING LEAD.

Vendors' assayer's dry assays	6, 6½%
Settled produce	5½
Wet assays, J. W. W., iodide	7.99, 7.97
electro deposition	7.99
Margin between wet and dry assays	2.23

BURNT ORES.

Vendors' assayer's results, 9%, will settle at	8½%
Buyers' assayer's highest produce	8½
Referee's assay	8½
Wet assays, J. W. W., iodide	10.174
electro deposition	10.176
Margin	2.05

I have known many samples of burnt ore similar to this settled under 1½ per cent. margin between wet and dry assays.

BURNT ORE.

Vendors' assayer's results	2½, 2½%
Buyers' assayer would not settle at a higher produce than	2½
(Which was accepted.)	
Wet assays, J. W. W., iodide process	3.60
electro deposition	3.61
Margin between settled produce and wet assays	1.23

Burnt ores with this percentage of copper are rarely settled with more than 1 per cent. margin between the wet and dry assays. Assuming this parcel to have been settled at 2½ per cent. (1 per cent. margin between the wet and dry assays), the difference in money value would amount to £31, and if the parcel had been settled at 2½ per cent., £15 more would have been received by the vendors.

That 1½ per cent. is a high margin for this percentage burnt ore is evident, from the following assays, of richer parcels of the same ore

	(a)	(b)
Vendors' dry assays	4½, 4½	4½
Wet assays, iodide process, J. W. W.	5.66, 5.71	5.71
Margin between wet and dry assays	1.16, 1.085	1.085

The above results, as well as the following ones, in my opinion, support the views of some persons, that a change in the method of valuation of copper ores and products is desirable. Take, for instance, the following assays of

COPPER MATTE.

Vendors' assayer sent produce	70½%
assay weighed	70½
Buyers' assayer's results (four trials)	69½, 69½
Another assayer's result	69½
Settled produce	69½
Wet assays, J. W. W., iodide	71.86
electro deposition	71.83
Margin between wet assay and "settled produce"	2.09

Large quantities of cupreous pyrites are used in the manufacture of sulphuric acid, the copper being extracted from the burnt cinders. The copper contents of these pyrites and cinders are bought and sold by the produce obtained by dry assays, and the results are often very unsatisfactory. The assays of a parcel of pyrites were as follows:—

WORKS WET ASSAY, 3.10% COPPER.

Wet Assays.

Iodide Process.	J. W. W.
50 grains	3.157%
60 "	3.175
150 "	3.161

100 grains electro deposition (J. W. W.) 3.194
Results rather high owing to traces of bismuth.

The vendors' assayer would settle this parcel at 2½ per cent.; but the buyers preferred referring if it could not be settled at 2½ per cent. The referee's return was 2½ per cent. In this case, the ½ per cent. which the buyers lost by referring would make about £10 difference in the value of the parcel. The referee, on being informed what the other assays were, stated that two concordant assays by the battery process had given 3.60 per cent. copper. If the sample had contained this per cent. of pure copper it would have given 2½ per cent. by dry assay; and, as he stated that the dry and wet assays in 2½ per cent. pyrites by dry assay are as 2:3, it is very evident that his results by electro deposition are not reliable.

The following assays, in which the same assayers acted respectively, as vendors' assayer, buyers' assayer, and referee, again show the very variable results which are obtained by the Cornish assay:—

ASSAYS OF CUPREOUS PYRITES.

Vendors' Assayer.	Buyers' Assayer.	Wet Assays.	Referee.
		Works.	J. W. W.
2½	2½	3.07½	3.34
—	—	3.11½	—
—	2½ baro	3.17	3.19
—	2½ bare	3.29	3.25
			2½

In the first case the buyers gained by the low dry assay ⅛ per cent. on the parcel, equal to a money value of £19 10s.; in the second case, assuming 2½ per cent. to be a fair settlement, they lost £37 10s.; in the third case, assuming 2½ per cent. to be a fair settlement, they lost £17; or, if 2½ per cent. is regarded as a fair produce, £34 on the parcel.

That the margins I have assumed are correct, will be evident from the following assays, which were compromised:—

CUPREOUS PYRITES.

Wet Assays (J. W. W.)	Works	Another Works	Settled Produce.
Iodide Process.	Wet Assays.	Wet Assays.	
3.42	3.40	3.38	2½
3.15	3.17½	3.13	2½
3.15	3.11½	—	—
3.01	3.01	—	2½
3.03	—	—	—
3.31	—	—	—
3.33	3.27	—	2½
3.34	—	—	—

Again, it is well known that by buying the copper contents of pyrites by Cornish dry assay, burning off the sulphur and selling the copper contents of the burnt ore, an increase of copper is shown; and, if the copper is extracted, made into copper precipitate, and sold by Cornish assay, a much greater increase occurs.

Thus, in buying pyrites containing 3 per cent. copper by accurate wet assay, the settled produce will be $2\frac{1}{2}$ per cent. This will yield 70 per cent. burnt ore, containing 4.28 per cent. copper by wet assay, and $3\frac{1}{2}$ per cent. by dry assay.

	Tons.	Cwt.
Actual amount of copper present in 10,000 tons of pyrites containing 3 per cent. by wet assay	300	0
Copper paid for by dry assay, at $2\frac{1}{2}$ per cent.	212	10

70 per cent. of burnt ore from pyrites = 7000 tons.

	Tons.	Cwt.
Actual amount of copper present in 7000 tons burnt ore containing 4.28 per cent. by wet assay (4.287 per cent.)	300	0
Copper sold by dry assay at $3\frac{1}{2}$ per cent.	227	10

Increase in apparent amount of copper present	15	0
---	----	---

	£.	s.	d.
Money value of 10,000 tons pyrites copper contents on basis of Swansea sale, April 21, 1885, at $2\frac{1}{2}$ per cent.	3000	0	0
Money value of 7000 tons burnt ore, copper contents on same basis at $3\frac{1}{2}$ per cent.	5425	0	0

Increase in value of copper contents, £2425; or per ton of pyrites 1.85 shillings.

By converting the copper into precipitate, the apparent amount of copper is still more increased.

Thus, assuming 10 per cent. copper on the pyrites is lost in manipulation, or left in the burnt ore, we have 2.90 per cent. extracted from 10,000 tons of pyrites = 290 tons. By converting this into precipitate, 86 per cent. by dry assay, with 1.625 per cent. margin = 87.625 per cent. wet assay; or 100 of copper by dry assay is equal to 101.89 by wet assay. The 290 tons of pure copper extracted from the pyrites would give 330.95 tons precipitate, containing 86 per cent. by dry and 87.625 by wet assay, equal to 284.62 tons of fine copper by dry assay.

	Tons.
Fine copper purchased in pyrites, $2\frac{1}{2}$ per cent. by dry assay.	212.5
Fine copper sold in precipitates 86 per cent. by dry assay, 87.625 by wet assay	284.62
Increase in the amount of copper sold	72.12

CONTRACTS FOR THE SALE AND PURCHASE OF COPPER ORES, ETC.

As details of the method adopted by assayers in agreeing produces are not generally known, the following description may be of interest.

In the printed forms of contract provided for the purchase and sale of copper ores and products, it is stipulated that sealed samples shall be forwarded, — one by the sellers to a Cornish assay master, and another by the buyers to another Cornish assay master, who are to agree the produce — a third sample to be sealed by the samplers, and held by them as a reference sample.

A certain number of copper assayers in Cornwall and Swansea are recognised as Cornish assayers, and practically all the assays required for commercial purposes are made by them; but I have been informed very recently that in a few instances copper ores are being purchased in England on the results of wet assays.

The vendors' assayer, after assaying his sample, forwards his results to the buyers' assayer, who has also examined a sample, and then a reply is sent, naming a produce, and proposing a settlement. In most cases wet assays have been forwarded by the principals to their respective assayers for their guid-

ance, and it is understood that settlements must not be made, unless there is a certain margin between the wet and dry assays, without further reference to the principals; and in some cases wet assays are made by several analysts, before a proposed settlement is rejected or accepted. Possibly half a-dozen letters may pass before a settlement is effected. In the event of their not agreeing, each assayer alternately nominates three of the recognised assayers, and one of them is selected by the other as referee. The decision of the referee, whatever it may be, is held to be final and binding on all parties; but instances have been given in this paper where the referee's results have been seriously at variance with those of the other assayers.

Apart from the errors and inaccuracy of the dry assay, a very serious objection to the present system is that it is almost impossible to obtain a reliable private assay. Thus, assuming a sample to have been settled in the usual manner, and it is considered advisable to have the results of a third assayer. A sealed sample forwarded to an assay master, with weight of parcel, ex-ship, names of buyer and seller, practically informs him who has previously examined the parcel; and, as correspondence is frequently passing between the assayers, very little difficulty is experienced in obtaining the "settled produces" sent to the principals. Cases are known to me which prove that this is by no means a theoretical objection.

The copper ores raised in Cornwall and Devonshire are sold at ticketings held at Truro and Redruth. When a mine has a parcel of copper ore for sale, notice is sent to the sampler, who samples the parcel carefully, placing portions of $\frac{1}{2}$ lb. to $\frac{1}{4}$ lb. each in a number of small bags, which are sent to the smelter's assayers, who exchange produces and compare results. In many cases also samples are sent to the smelter's works, where they are tested by wet assay, and also assayed for silver. The results of the assays are forwarded to the smelters, who make a written offer on a ticket for the ore. These are handed in at the ticketings, the highest tender obtaining the parcel; but where two tenders are alike it is divided. After the sale the buyers' agent weighs over the parcel, the moisture is taken, and the actual weight calculated to 21 cwt. of dry ore per ton.

Ores, matte, etc., from abroad, were formerly largely imported into Swansea, and ticketings were held there. For some time past, however, large quantities of matte, ore, bar copper, etc., have been brought into Liverpool and disposed of by private contract. This has also been the case at Swansea, and in consequence the public ticketings or Swansea sales have been of rare occurrence, the last five being held on the following dates:—

1883	February 27, May 1, August 14, December 4.
1884	No public ticketing.
1885	April 21.

No ticketing since.

For the purpose of comparing the price of copper ores, or rather of "fine copper" in the ore, the "standard" is used. This is the price of one ton of fine copper in the ore—plus the "returning charges," the latter being calculated at 45s. per ton of ore (of $8\frac{3}{4}$ per cent. produce) for the Swansea sales, and 55s. per ton of ore for the Cornish sales, it being assumed that the extra 10s. per ton in the latter case is extra cost incurred in removing the ores from Cornwall to the smelter's works in Wales.

The following examples illustrate the method used in calculating the standard from the results of the Cornish ticketings:—

Rule.—Multiply the number of tons of ore by 55s. to obtain the total returning charges; add this to the money value of the sale, and divide the product by the weight of fine copper—the quotient is the standard for the sale.

Redruth Sale. September 4, 1884.

Average produce $6\frac{1}{2}$ 985-21cwt.
 Price per 21cwt., £2 12 6 Money, £2591 12 0
 Fine copper 63 tons 6cwt. = 63 $\frac{1}{2}$ tons.
 Standard £83 15 0 for $6\frac{1}{2}$ per cent.
 (55' - × 985) ÷ £2591 12 0
 63 3
 = £83 15 0

Truro Sale. September 18, 1884.

Average produce $5\frac{1}{4}$ 2289-21cwt.
 Price per 21cwt., £2 9 0 Money, £5597 7 6
 Fine copper 131 tons 16cwt. = 131 $\frac{1}{2}$ tons.
 Standard £88 4 0 for $5\frac{1}{4}$ per cent.
 (2289 × 55/-) ÷ £5597 7 6
 131 $\frac{1}{2}$
 = £88 4 0

The standard of the Swansea sales is calculated differently—in this case a variable returning charge, depending on the average produce of the ore at the sale being used. This average produce is obtained from what is termed the “settled list”—i.e., the produces agreed on at a conference by the smelter’s assayers, and which are kept as far as possible secret.

On examining the Swansea list of April 21, 1885, a column will be found headed “Produce.” The results inserted under this heading are those of assays made on behalf of the sellers, while the blank columns adjoining are for the smelter’s private assays, and the “settled” produces. Thus, while the total amount of copper by the Swansea list (April 21, 1885) amounted to 171 tons, 5cwt., 1qr. 15lb., the fine copper by the settled list was 167 tons, 17cwt., 1qr. 15lb., and as the number of 21cwt.-tons. of ore was 1541—the average produce was 10 $\frac{8}{9}$ 93 or 10 $\frac{1}{2}$ per cent. The variable returning charge for this percentage is £2 12s. 11d.—the standard being calculated as follows :—

Money value of sale £6154 15 6
 Fine copper, 167 tons 17cwt., 1qr. 15lb. = 167 $\frac{869}{1000}$ tons.
 (1541 × £2 12 11) ÷ £6154 15 6
 167 $\frac{869}{1000}$
 = £60 19 0
 Or approximately £61 0 0

The great distinction between the standards of the Cornish and Swansea ticketings, is that in the former the returning charge is constant, whatever the average produce of the sale; while in the Swansea sales the returning charge varies with the average produce of the sale, 45s. being the returning charge (R.C.) for 8 $\frac{3}{4}$ per cent. produce, and also that the calculation is made from the assayers’ settled list, and not from the produces given in the Swansea copper ore circular.

It must, however, be most distinctly understood that the “standard” is calculated from the prices paid for copper ores, and not the reverse.

The chief reason why I have entered into detail regarding these sales is that, until recently, contracts for the purchase of cupreous pyrites were in force, based on the price of copper ore at the Swansea ticketing immediately preceding the day of delivery; or, if a Swansea ticketing was held on that day, the price was to be calculated from it. This method is, however, now only used in one or two cases, the principal one being where the sulphur contents of pyrites are sold to alkali makers, the vendors taking back the burnt cinders for the extraction of the copper. The pyrites and burnt ores are examined by dry assay, and the value calculated from the standard of the last Swansea sale R.C. 45s.; but in this case it is simply used as a matter of form, for the apparent gain in the value of the copper is commuted to a definite payment per ton of pyrites burned.

The Swansea sales being now of rare occurrence, an interval of sixteen months elapsing between the

two last, and the price of Chili bar copper declining in the interval from £59 to £44, resulted in serious loss to buyers who had purchased on this basis. The prices of Chili bar copper, the standard of the two last sales, and the price of 2 $\frac{1}{2}$ per cent. R.C. 38s, were as follows :—

Swansea Sales.

	Dec. 4, 1883.	April 21, 1885.
Chili bar copper	£59 5 0	£44 1 0
Standard Swansea Sale	76 10 0	61 0 0
Price of 2 $\frac{1}{2}$ R.C. 38 - on basis of	0 19 6	0 13 0
Swansea sale		

A difference of 6s. 6d. per ton in the price of pyrites containing 2 $\frac{1}{2}$ per cent of copper by dry assay. This excessive difference in value rendered a change in the basis of valuation desirable, and large sales of pyrites were made, the value of the copper contents being calculated from the price of Chili bar copper in the following manner :—

The price of the pyrites to be calculated from the “settled” dry assays at the rate of one shilling per unit per ton for every five pounds in the price of Chili bar copper, good ordinary brands, cash price of 96 per cent., with a deduction of 1s. 6d. per unit from that figure.

Thus the price of 2 per cent. by this method, with Chili bar copper at £50 per ton, is 17s.

Another method, which is coming more into favour, is deduced from the price of Chili bar copper in the following manner :—The “standard” of Chili bar copper is calculated by means of the variable returning charge (V.R.C.), and from this the price of the ore is deduced.

I have previously mentioned that the standard of the Swansea sale is obtained by means of a V.R.C., depending on the average produce of the mineral sold. The method employed in calculating this is extremely simple, but it is not generally known even to buyers or sellers of copper ores. The 45s. Swansea returning charges is for 8 $\frac{3}{4}$ per cent only, others being derived from it in the following manner :—For each unit of produce 3s. 9d. is taken, with an addition of 12s. 2d., fractions of units being allowed for as below :—

	s. d.
1	0 5
2	0 11
3	1 5
4	1 10
5	2 4
6	2 10
7	3 3
8	3 9
Thus 8 $\frac{3}{4}$ %	
s. d.	s. d. 3%
(3 9 × 8) ÷ 12	2 2 10
	= £2 5s. 0d.

And other produces in a similar manner.

The returning charge for Chili bar copper 96 per cent. is thus—(3s. 9d. × 96) ÷ 12s. 2d. = £18 12s. 2d. This, added to the price of the metal, the product multiplied by 100 and divided by 96, gives the “standard.” If the price of Chili bar copper is £50 per ton, then

£	s.	d.
50	0	0
Returning Charge	18	12 2
	68	12 2
		100
96)		
	71	9 4 Standard.

From this the price of any produce is calculated by multiplying the standard by the produce and dividing by 100; the variable returning charge is subtracted from the quotient, and the remainder is the price at 45s. 0d. R.C. If the price is based on any other re-

turning charge *lower* than 45s. per ton, the difference is *added* to the price of the ore, while if the returning charge is higher it is deducted from it.

The price of cupreous pyrites containing $2\frac{1}{2}$ per cent. of copper by dry assay, by the two methods of valuation based on the price of Chili bar copper at £40 per ton 96 per cent., is as follows:—

First method, 1s. per unit for every £5 in the cash price of Chili bar copper 96 per cent., with a deduction of 1s. 6d. per unit from this figure,

	s.	d.
Deduct	8	0
	1	6
	6	6
		$2\frac{1}{2}$
	11	$7\frac{1}{2}$

Second method by variable standard at 38s. returning charge—

	£	s.	d.
Price of C.B.	40	0	0
V.R.C.	18	12	2
	58	12	2
			100

96)

Variable	Standard	61	1	0
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61	1	0
		$2\frac{1}{2}$

100)

1	7	5
---	---	---

Deduct V.R.C.
($3/9 \times 2$) + 12×2 + 11d.
(for $\frac{1}{4}$)

1	0	7
---	---	---

0	6	10
---	---	----

Add difference
between 45/ and 38/ R.C.

0	7	0
---	---	---

0	13	10
---	----	----

The comparison of prices at the time of the last Swansea sale is also instructive. The standard of the sale was £61 0s. 0d. The average price of Chili bar copper, 16—30th April, 1885, was £44 1s. 0d., variable standard £65 5s. 4d., and the price of $2\frac{1}{2}$ per cent. copper at 38s. R.C. by the various methods is as follows:—

	By first method 1/ per unit for every £5 in C.B. copper, etc.	s.	d.
R.C. 38/	By Chili bar variable standard	15	7
	By Swansea sale	13	0

The two methods of fixing prices on the basis of the price of Chili bar copper give the following results with different produces:—

Price of C.B. Copper, £40 0s. 0d.

	1%	2%	3%
1/ per unit method	6s. 6d.	13s. 0d.	19s. 6d.
Variable standard method R.C. 38/	3s. 3½d.	11s. 9d.	£1 0s. 2½d.

From the fact that Swansea sales are now of comparatively rare occurrence, and also that the basis on which the copper contents of pyrites have been valued has been found very unsatisfactory, it seems to me that in new contracts a much more reliable method may be devised. Thus the uncertainty, annoyance, and often heavy pecuniary loss, caused by the discordant and unreliable results of the dry assays, may be avoided by taking the wet assays made by the iodide process as a standard method, and deducting a definite fixed margin (varying with the percentage) from these results representing the difference between the wet and dry assays, the remainder being charged as copper by either of the methods given previously. An illustration will show more clearly how the basis would be arrived at. A parcel of pyrites contains 3·00 per

cent. of copper by wet assay—from this a deduction of $\frac{1}{3}$ per cent. or '875 would be made, leaving 2·125 or $2\frac{1}{4}$ per cent. on which produce payment would be made. For pyrites assaying $3\frac{1}{2}$ to 4 per cent. of copper by wet assay, I would deduct 1 per cent. margin.

The advantage of this method would be that perfectly reliable results, much more trustworthy than dry assays, would form the basis of value, and the buyer knowing exactly the amount of copper he would obtain, could make his calculations regarding price and profit with more certainty than at present. Again, it is a well-known fact that much dissatisfaction exists regarding the "margin" between the wet and dry assays, buyers contending that it is not what they have been led to expect, and on which they have based the price payable under their contracts; while selling assayers are complaining that they are checked in all directions, and that it is simply a question of dry assays, and buyers must look after their own interests when fixing prices. This is especially the case with rich copper mattes, and much friction has occurred regarding the settlements of these products.

An objection may be urged that copper extractors would still have to sell their precipitates by dry assay; but I think there can be no doubt if once a good and reliable process of wet assay is introduced for contract purposes, it will be used for buying and selling all classes of copper products, and the fact that by making a certain deduction to be termed the "margin" from the wet assays, the remainder can be used as an equivalent to the present dry assay, no other changes would be necessary, renders this method a most desirable one.

In those cases where the sulphur contents only of pyrites are sold, the burnt ores being returned to the vendors for the extraction of the copper, careful wet assays would supply the necessary check on the quantity of copper sent to and returned from the buyers of the sulphur contents.

Copper ores, mattes, precipitates are generally sold at a certain price per unit of copper determined by dry assay, but sometimes this is varied in the following manner: The price shall be based on 8s. (or other sum) per unit for 20 per cent. (or other produce), and if the produce varies from this a *pro rata* augmentation or deduction shall be made.

Required—price of 12 per cent. at 8s. per unit for 20 per cent.

	£	s.	d.
$8/ \times 20$	8	0	0
R.C. ($3/9 \times 20$) + 12×2	4	7	2
	12	7	2
			100
20)			
Variable	61	15	10
Standard			12
100)	741	10	0
	7	8	3
Variable R.C. 12%	39	12	2
Price of 12%	4	11	1

Or 7s. 7d. per unit.

CHILI BAR COPPER CONTRACTS.

Chili bar copper is sold on the basis that it shall contain not less than 96 per cent. pure copper, and the wording of the printed forms of contract, which were adopted by the London Metal Exchange so lately as August, 1883, show that details regarding the methods of assay are even yet not known to

* This method, making an allowance from the results of wet assays, is used in the United States, where wet assays are invariably used for determining the value of copper in ores and products. See Journal of the Society of Chemical Industry, January, 1885, p. 30.

of the day of sampling; interest at the rate of 5 per cent. per annum to be allowed for any earlier payment; also rent up to prompt date.

"Any dispute on this contract to be settled by arbitration according to Rule 2.

"Rules.

"No. 1. Members are responsible to each other only for the fulfilment of every Contract in which another principal is not mentioned by name.

"No. 2. All disputes arising upon Contracts shall be referred to two arbitrators, one to be chosen by each party in difference, the said arbitrators having power to call in a third in case they shall deem it necessary. In the event, however, of one of the parties appointing an arbitrator, and the other refusing, or neglecting to do so, for seven days after notice in writing of the appointment (such notice being delivered personally or left at the usual place of business of such other party), or in case of the death, refusal to act, or incapacity of either of such two arbitrators; then upon application of either of the disputing parties, the question in dispute shall stand referred to the arbitrator named by one of the contending parties and another arbitrator, who shall be appointed by the Committee of the London Metal Exchange, at a meeting convened by notice, and at which not less than three members shall be present. In case the two arbitrators appointed as aforesaid, whether originally or by way of substitution, shall not within fourteen days after their appointment agree to an award or choose a third arbitrator, then the Committee of the Metal Exchange, at a meeting constituted as herein before provided, shall appoint a third arbitrator, and shall, in case of death, refusal to act, or incapacity of any of such three arbitrators, from time to time substitute a new arbitrator or arbitrators in the place of the arbitrator or arbitrators so dying, refusing, or incapacitated. In making their reward the arbitrators shall state which party or parties are to pay expenses of arbitration, and the award of two arbitrators, in writing, shall in every case be conclusive and binding on the parties to the arbitration.

"No. 3. The prompt on arrival Contracts shall be fourteen days from notice of final passing of landing scales, except on Chili Bars, which shall be fourteen days from date of sampling, of which due notice shall be given. No notice of final passing of landing scales or sampling shall be valid unless the warrants are ready at time of such notice.

"No. 4. Sellers of arrival parcels shall advise buyers of any information which they may have from the shippers in regard to the weights or otherwise as soon as received.

"No. 5. Sellers shall tender documents not later than 3.30 p.m. on the prompt day; except the prompt fall on Saturday, when the tender shall be made by 2 p.m.

"No. 6. If the sellers fail to deliver on the prompt day, the buyers shall be entitled to buy in against them, either publicly or privately, on the next morning's 'Change; or if the buyers fail to take delivery on the prompt day the sellers shall be entitled to sell out against them, either publicly or privately, on the next morning's 'Change, and the person or persons in default shall at once pay the loss, if any, by repurchase or re-sale, or receive the profit, if any, in like manner. The buyers or sellers, as the case may be, who claim to act under this clause shall send written notice on the prompt day, to the person or persons in default, that action in conformity therewith will be taken.

"No. 7. When buyers and sellers agree to settle outstanding Contracts between them by a difference account, such differences shall be calculated on the exact Contract weight without any deduction whatsoever therefrom.

"a. All imports of Chili Bar Copper are to be weighed in drafts of 5 bars each, and warrants issued as far as possible for 25 tons each, and one for the balance, if any—e.g., taking an import of 99 tons, three warrants would be issued for 25 tons each, and one for balance of 24 tons; or, taking an import of 101 tons, then four warrants of 25 tons each and one for the balance of 1 ton. An assay certificate to be attached to each warrant. On all Contracts for Chili Bars, Warrants may not be tendered for fractional parts of 25 tons unless they together make up a quantity of 25 tons, and lying at one port.

"c. On all Contracts for Foreign Copper, one per cent. more or less on gross weight may be delivered, and at Contract price, but if the excess or efficiency exceed one per cent., then the whole difference in weight, without deduction of draft, is to be settled at the mean official quotation of the Committee of the

Metal Exchange of the evening previous to the day of settlement. A delivery shall be accepted as good so long as the deficiency or excess, as the case may be, does not exceed five per cent. on the gross weight tendered.

"d. All Contracts for Foreign Copper, unless specially arranged otherwise, shall carry a prompt of 14 days, and the buyers shall have the right to take up the warrants on any day before that prompt date under allowance of interest at 5 per cent. per annum; also rent for the unexpired portion of that prompt, but notice of such uplifting must be given at latest by twelve noon on the day on which delivery of the warrants is required. If the sellers fail to deliver as per notice, they shall allow interest as if the warrants had been duly delivered on the day required; but sellers shall not be entitled to more than one clear day's grace.

"e. Chili Bar warrants without assay certificates may not be refused, but the buyers need only pay for them on account, say within two per cent. of the invoice amount; the balance to be paid on production of the assay certificate. No new brand of Chili Copper shall be tendered on a Contract for G.O.B.'s unless accompanied by a certificate of two Cornish assayers that the quality is *good ordinary*. If the quality be thus certified as "good ordinary," then such brand shall be considered as a lawful tender, but if it be not up to said standard it may be rejected, and the sellers shall provide a similar quantity of a recognised brand within 24 hours of day of notice of such rejection, and which must be given by buyers in writing. Should the tender be made on an "arrival" Contract then the prompt shall date on or from the day the certificate is tendered to the buyers according to terms of Contract."

THE ASSAY OF GOLD IN BAR COPPER.

Bar coppers containing silver and gold are often bought and sold in the English market, and the results of various assayers have frequently been compared with my own assays.

The general tendency is for the gold produce to be low, sometimes to a serious degree, even in the results of practising assayers. I believe this is due to some extent to the insufficient weight of material operated on; for a long time I could not persuade my then employers to use more than $\frac{1}{2}$ oz. of copper chips for assay; in this case an error of '001 grain in the weight of the gold would amount to 3dwts. of gold per ton of copper. Subsequently I made assays on 1oz. of chips; in this case '001 grain, representing 1½dwts. per ton; but by careful weighing this could be reduced one half, or to 18 grains per ton.

I was informed that one assayer made his gold assays on 100 grains of copper chips. In this case '001 grain in the weight of the gold, representing 6½dwts. per ton; and it must be remembered that the value of this gold varies from 2s. to 3s. 6d. per dwt.; hence the necessity for careful and accurate work.

The following are results obtained by other assayers and myself examining samples for commercial purposes:—

Half-ounce assays. Per ton of 2240lb. avoird.	J. W. W.			Buying Assayer		
	oz.	dwts	grs.	oz.	dwts.	grs.
	1	0	23	+1	1	12
	1	3	21	+1	1	12
	0	8	23	:0	8	0
1 ounce assays	1	3	21	+1	1	12
	0	18	16	+0	17	0
No value	0	6	17	+0	8	0
	0	6	17			
	0	19	9	+0	16	0
	0	4	18		17	0
No value	0	4	16	+0	3	0
	1	3	21	+1	4	12
	0	12	6	+0	7	12

In this case the buying assayer first offered 7dwts 12 grains, then 8dwts., but would not name referee when requested. He then offered 10dwts., and

finally settled at 11dwts. If this sample had been settled as the buying assayer wished, the gold value would have been nil, at 11dwts. the value was approximately £25.

J. W. W.			Buying Assayer.			Referee.		
oz.	dwt.	grs.	oz.	dwt.	grs.	oz.	dwt.	grs.
8	19	22	8	10	0	8	19	12
—	—	—	—	—	—	—	—	—

HALF OUNCE TRIALS AND RE-ASSAYS—

8	10	5	Buyers will settle both parcels at			7	16	0
8	11	7				7	16	0
8	17	7						
8	16	5	8	4	0			

HALF OUNCE ASSAYS—

1	9	20	—	—	—	1	6	0
1	8	8						

ONE OUNCE ASSAYS—

8	11	7	8	10	0	settled
8	5	15	8	0	0	„

HALF OUNCE ASSAYS—

1	0	21	0	11	0	1	4	12
0	11	22	0	8	0	0	12	0
0	11	22	0	8	0	0	16	8

The following series are also interesting $\frac{1}{2}$ oz. trials :

	<i>J. W. W.</i>			<i>Buying Assayer.</i>			<i>Referee.</i>		
	oz.	dwt.	grs.	dwt.	dwt.	oz.	dwt.	grs.	
<i>a.</i>	1	5	9	13	0	1	0	12	
<i>b.</i>	0	11	22	6	12	9	0		
<i>c.</i>	6	11	22	6	12	9	0	16	
re-assay	0	16	10	6	12	9	0	12	
<i>d.</i>	0	11	22	6	12	9	0		

The buying assayer in this case suggested that one of the samples *b*, *c*, *d*, should be referred, and that the result should be taken to represent all three parcels ; this was agreed to if he would refer *c*, and the result is shown above.

The following is a most serious case :—

	oz.	dwt.	grs.	
J. W. W.....	12	6	9	
Buyers' assayer & re-assay	10	11	0 ¹ / ₂	loss, per ton difference in
But will settle at	11	10	0 ¹ / ₂	value of gold by these assays.
Referee's return	12	1	0	

In this case the difference in gold value between the buyers' assay and the referee's return is £4 14s. 6d. per ton, while the difference in the referee's return and my assay amounts to 18s. 9d. per ton.

The assays marked + were made by a London assayer, those marked ‡ by assayers employed in works, those marked || by copper assayers, but not the same assayer in all cases, while my initials indicate assays made by me.

It is evident from the results given that the assays of gold in bar copper are not conducted as carefully as they should be, taking the value of the metal into consideration.

In conclusion, I wish to express my opinion that the discrepancies I have pointed out are due in most cases to careless work and the use of inaccurate methods of analysis and assay, and in a very minor degree to errors of sampling. The results I have brought forward are the actual figures which have been obtained in the examination of samples for commercial purposes. I desire also to express my thanks to those gentlemen who have assisted me in the preparation of this paper, either by furnishing me with the forms of contract used in the copper trade, the respective prices of gold and copper, or with the methods of assay used in their laboratories.

Finally, I would submit the following propositions :—

(a) That the temperature at which the moisture in copper ores, etc., is determined, should be more clearly defined than it is at present.

(b) That for the wet assay of copper in ores and products generally, the iodide process (E. O. Brown's modification) is the most reliable and accurate, but

that the electro-deposition method may also be used in cases where it is desirable to have results of *two separate and distinct processes*, it being noted that in certain cases other metals are deposited with the copper.

(c) That the Cornish process of dry assay is very inaccurate and misleading, and is also liable to serious variation in the hands of experienced operators : these reasons, together with the fact that it is extremely difficult to get reliable private assays, render its use undesirable.

(d) That in cases where the sulphur contents of pyrites are sold to alkali works, the burnt ores being returned to the vendors, an accurate wet assay forms the best check on the copper contents of the ore delivered to and received from the alkali works.

(e) That a more suitable basis for the valuation of copper in ores and products may be found in wet assays made by the iodide process, deducting an allowance (or "margin" to be agreed on by vendors and purchasers) from these results, thus bringing down the percentage to the dry assay produce, and calculating the value by methods at present in use, or given previously in this paper.

(f) That many assays of gold in bar coppers, made by recognised assayers, are very inaccurate.

Liverpool Section.

Chairman : E. K. Muspratt.

Vice-Chairman : Prof. J. Campbell Brown.

Committee :

Enstace Carey.	A. Norman Tate.
John Hargreaves.	J. Affleck.
E. Milner.	J. C. Gamble.
C. Symes.	Douglas Herman.
F. Hurter.	Alexander Watt.
H. Brunner.	E. G. Ballard.

Local Sec. : W. P. Thompson, 6, Lord Street, Liverpool.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

3rd March.—Mr. James Longmore : "Researches on the Colouring Matter and Mucilage of Cotton-seed Oil ; with a Description of a New Method for Recovering the Position lost during the Refining Process."

Meeting held Wednesday, 13th January, 1886, at University College, Ashton Street.

THE PRESIDENT IN THE CHAIR.

THE CHAIRMAN announced the resignation of Mr. E. G. Ballard as Hon. Local Secretary, and the election of Mr. W. P. Thompson in his stead.

On the motion of Mr. NORMAN TATE, seconded by Dr. CAMPBELL BROWN, it was resolved to form a committee to make arrangements for the reception of the Society at the Annual Meeting in July.

MR. ALEX. WATT made a communication on "An Electrically-driven Centrifugal Machine for Laboratory Use," and exhibited it in action. (See Journal, vol. iv. p. 754.) The discussion turned chiefly on the practical uses of centrifugal machines.

Dr. CAMPBELL BROWN, after pointing out the cleanliness and easy transmission of electricity as a motive power, asked if the author could give them any notion of its relative cost compared with other sources of power?

The CHAIRMAN said that twenty years ago he had tried centrifugal machines for separating the red

liquor from caustic salts, but the result was unsatisfactory.

Mr. SIMPSON agreed with the Chairman, and said that they now used a filter-press for the purpose, which turned out some twenty tons a day. The centrifugal machine was also quite useless for lime-mud.

Dr. CAMPBELL BROWN admitted that centrifugal machines were no use for gelatinous precipitates, such as hydrated oxide of iron.

Mr. WATT suggested that a centrifugal machine was better adapted for crystals than a filter-press, as the latter was liable to crush them.

Mr. SIMPSON dissented from this view.

The CHAIRMAN said that, according to the author's calculation, a centrifugal machine would turn out ten tons of crystals per day of ten hours. Filter-presses could not be compared with centrifugal machines, as they were each used for entirely different classes of substances. In his own new process for making potassium chlorate, by means of magnesia in place of lime, he used a centrifugal machine to free the crystals of magnesium chloride from mother-liquor, and at least five tons a day could be thus obtained. The men engaged on the process were not solely occupied in working the machine, so that he could readily accept the author's estimate of the work capable of being done. For caustic salts or lime-mud, undoubtedly the machine was less suitable, but for crystals of magnesium chloride he was quite satisfied with its efficiency.

Dr. HURTER said that the machines at the works of his firm were six feet in diameter, and were placed on the first floor of the house. The vibration was, however, so great that he had to reduce the speed to from 300 to 400 revolutions per minute. Two of these machines could dry about 300 tons of crystal carbonate per week, but he agreed that their efficiency depended largely on the class of substance dealt with. For instance, they were quite useless with lime mud.

Mr. WATT, in reply to Dr. Campbell Brown, said that the cost had not been ascertained, but he might point out that in the case of the Weston suspended drum machine, the electrically-driven one worked much more steadily than that driven by belting. In reply to Mr. Simpson, the 30in. machine would turn out about 1½ cwt. of dried sugar crystals every five minutes. At the same time, some kinds of sugar took about a quarter of an hour to dry.

A COMMUNICATION on "Some Experiments on Purifying Distillable Oils" was then read, in the discussion on which the President, Mr. Norman Tate, Dr. Campbell Brown, Mr. W. P. Thompson, and others took part.

Meeting held 3rd February, at University College, Ashton Street.

MR. J. CAMPBELL BROWN IN THE CHAIR.

THE LOCAL SECRETARY exhibited samples of fibre, yarn, flooreloth, trouserings, and broadcloth made from peat-fibre by a new French process.

Dr. OLIVER LODGE then read a paper on "The Electrical Deposition of Dust and Smoke, with Special Reference to the Collection of Fine Metallic Fume, to the Possibility of Diminishing the Escape of Solid Matter from Chimneys by the Electrification of the Air inside them, and to the Electrical Purification of the Atmosphere." A copy of this paper, with the discussion thereon, will appear in a future number.

Manchester Section.

Chairman: Sir H. E. Roscoe.

Vice-Chairman: I. Levinstein.

Committee:

R. F. Carpenter.

C. Estcourt.

H. Grimshaw.

B. W. Gerland.

Peter Hart.

T. Jackson.

D. B. Hewitt.

C. Schorlemmer.

Watson Smith.

L. Siebold.

Wm. Thomson.

D. Watson.

Local Secretary:

J. Carter-Bell, Bankfield, The Cliff, Higher Broughton, Manchester.

MEETINGS, SESSION 1885-86.—First Tuesday in each Month, at 7 P.M.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

FURTHER NOTES ON THE METHODS OF EXAMINING AND CHEMISTRY OF FIXED OILS.

BY ALFRED H. ALLEN.

In a paper read before the London Section of the Chemical Society of Industry about three years since, I reviewed the general condition of our knowledge of the chemistry of fixed oils, and described some of the more definite methods applicable to their assay and analysis. The subject has made considerable advances since that time, and I have been at some trouble to collect and collate the results of various workers. The paper which I propose to lay before you this evening will, therefore, be the result of this collation, supplemented by observations of my own in cases where the information at hand seemed insufficient.

Specific Gravity of Oils.—A very satisfactory method of determining the density of fixed oils is by means of Westphal's *hydrostatic balance*. A counterpoised thermometer, suspended from a piece of thin platinum wire, is attached to one end of a graduated lever. On immersing the thermometer in a liquid, it loses a certain weight. The equilibrium is restored by hanging on the lever a series of riders, which are adjusted in weight so as to make the reading very simple.* The plummet displaces exactly 5cc. of liquid, and hence the weight required to restore equilibrium is that of 5cc. of the fluid of which the density is required. Differences of 0.2 are appreciable, so that the indications are equal in delicacy to those of the specific gravity bottle, and considerably more accurate than the readings of a hydrometer. As the employment of a thermometer as a plummet renders the instrument unsuited for determinations of density at 100° C., or other high temperatures, I substitute, in such cases, a plummet of thick glass rod, having a displacement of exactly 5cc.

It is evident that a special balance and riders for taking densities by a plummet are by no means essential. If a plummet of known displacement be suspended from one arm of a balance and duly counterpoised, on immersing it in a liquid it will lose a portion of its weight equal to the weight of an equal volume of the liquid employed; and this loss being ascertained by adding weights sufficient to restore equilibrium, the specific gravity of the liquid will be found by dividing the weight in grammes employed by the volume of the plummet in cubic centimeters. If a plummet of 10cc. displacement be employed, the density of the liquid will be one-tenth of the weight in grammes required to restore equilibrium.

* Westphal's balance can be obtained from Messrs. Beeker & Co., Maiden Lane, E.C.

The glass plummet may be brought approximately to the desired bulk by noting its displacement. Its specific gravity is then carefully determined by weighing it in distilled water, when the exact weight of 5 or 10cc. is readily calculated, and it is brought to this weight by careful grinding or filing.*

The use of a plummet of exactly 5 or 10cc. displacement facilitates calculation, but in its absence a plummet of any known measure can be employed, and this measure can be ascertained by dividing its weight in grammes by its specific gravity. The weight lost by the plummet on immersing it in any liquid, divided by the measure of the plummet, gives the specific gravity of the liquid.

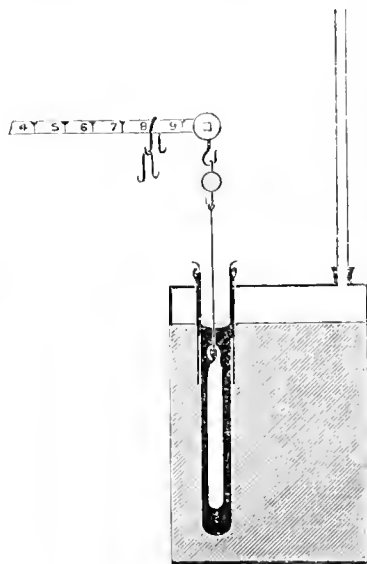
My experience fully convinces me that the archimedeal or plummet method of taking the specific gravities of liquids deserves a wider application than it has hitherto received.

In my last paper I pointed out that the specific gravity of an oil was by no means an unmeaning character, but was a definite indication of its nature and chemical constitution. Thus, sperm and bottle-nose oils, which have the constitution of waxes, and are not glycerides, like the majority of fixed oils, have the lowest specific gravity. There is a great gap between these and the animal and vegetable oleins or non-drying oils, as represented by olive, almond, and lard oils. Rape oil may be classed in this group, but its constitution is sensibly different from that of the majority of vegetable oils. The drying oils, again, as typified by linseed oil, are sensibly denser than the non-drying oils; while castor oil exceeds all other natural fixed oils in density, and exhibits peculiarities in its physical properties and constitution which sharply distinguish it from almost all other natural oils.

I may here point out that the density of an oil is liable to be very materially altered by certain treatment, or even by keeping. Some three years ago I examined a sample of porpoise oil, which then had a density of 920; the sample now has a density of 926, though the proportion of free acid is not very materially increased. Another portion from the same sample, kept under different conditions, has now a density of 932. In all probability these changes are due to oxidation and are analogous to the change now brought about in rape oil, cottonseed oil, linseed oil, etc., which by a process of regulated oxidation are caused to acquire a density as high as 960; in that respect, as well as in their viscosity, simulating closely castor oil. These "blown oils," as they are called, are now manufactured as substitutes for castor oil, though, unlike the latter, they are perfectly miscible with mineral oils; but I am not prepared to say that their use is an advantage in other respects.

It is well known that butter fat, cocoa nut oil, and other fats containing the glycerides of lower fatty acids, are denser than lard, butterine, and similar fats not containing sensible quantities of such glycerides. The difference, however, is not very great; and in order to observe it satisfactorily, it is necessary to take the density of the fat in a molten condition. A temperature of 100° F. was adopted by Dr. J. Bell, but Mr. Charles Esteourt, in 1866, recommended that the fat should be heated to the boiling-point of water, and in my last paper I strongly urged that the density should be taken at the latter temperature, and recommended a Sprengel-tube as a suitable instrument for the purpose. Extensive experience of this method since the publication of my last paper has fully

confirmed the favourable opinion of it I then expressed. It enables one to compare the densities of all fats and waxes when in a fluid state; and only those who have tried have any idea how difficult it is to obtain concordant figures for the densities of waxes and similar bodies when the experiments are made on the solid substances. I have, however, in all cases where there is sufficient substance at disposal, abandoned the use of the Sprengel-tube in favour of the plummet, the use of which leaves nothing to be desired on the score of rapidity, accuracy, or ease of manipulation. The application of the Westphal balance to the determination of the density of butter and other fats at the boiling-point of water was, however, originally recommended by Mr. Charles Esteourt (*Chem. News*, xxxiv. 254), the details of the manipulation being further described by Mr. J. Carter Bell (*Chem. News*, xxxviii. 267). These chemists, who have habitually employed the method, immerse the tube containing the fat to be examined in a bath of molten paraffin, which is kept at a constant temperature by an outer vessel of boiling water. In my experiments, I have abandoned the intermediate bath of paraffin as unnecessary, and employ a cylindrical copper bath, the top of which is closed and perforated by two orifices. One of these is fitted with an upright tube, which serves to carry the steam away from the neighbourhood of the balance; while into the other the tube containing the fat fits tightly, the joint being made perfect by a ring of



cork or indiarubber. Any of the usual arrangements for keeping the water at a constant level can be employed, if desired, but I have not found this requisite.

The following table gives the densities, as determined in my laboratory, of a number of samples of oil at the temperature of boiling water. Some of the observations were made with the Sprengel-tube, and others by the plummet; but, in each case where both methods were employed, the results showed such a close concordance that I consider it a matter of indifference, so far as the figures are concerned, which method was used. In most cases, the density of the same sample was taken at the ordinary temperature in addition, these results being in some instances obtained by a hydrometer:—

* Mr. E. Casella, of 147, Holborn, E.C., supplies accurately-adjusted glass plummets and counterpoises for employment with an ordinary balance.

SPECIFIC GRAVITIES OF OILS, ETC.; WATER AT 15.5° C. (= 60° F.) = 1000.

OIL.	At 15.5° C. (= 60° F.)	At 98° to 99° C. (= 209° to 210° F.)
Arachis oil	922*	867.3
Rape oil	915*	863.2
Neatsfoot oil	911*	861.9
Cotton-seed oil	925*	872.5
Sesamé oil	921*	867.9
Cocoa-nut oil	926.2	871.0
Niger-seed oil	927*	873.8
Linseed oil	935*	880.9
Castor oil	965.5	909.6
Whale oil	950.7	872.5
Porpoise oil	926*	871.4
Seal oil	924*	873.3
Cod-liver oil	927.5	874.2
Menhaden oil	932*	877.4
Sperm oil	883.7	830.3
Doegling (Bottle-nose) oil	880.8	827.4

The next table shows the specific gravity, at two different temperatures, of various molten fats and other bodies which are solid at the ordinary temperature. The densities were ascertained by the plummet method, and in each case the observations at the two different temperatures were made on *the same sample* of the substance. A column is added showing the difference in density corresponding to a change of 1° C.

FAT, ETC.	Specific Gravities of melted Fats, etc.; Water at 15.5° C. (= 60° F.) = 1000.	Difference for 1° C.
Palm oil	893.0 at 50° C. 858.6 at 98° C.	.717
Cacao butter	892.1 at 50 857.7 at 98	.717
Japan wax	901.8 at 60 875.5 at 98	.692
Tallow	895.0 at 50 862.6 at 98	.675
Lard	898.5 at 40 860.8 at 98	.650
Butterine	898.2 at 40 859.2 at 98	.672
Butterfat	901.1 at 40 867.7 at 99	.617
Cocoa-nut oil	911.5 at 40* 873.6 at 99	.612
Palm-nut oil	911.9 at 40* 873.1 at 99	.657
Spermaceti	835.5 at 60 808.6 at 98	.716
Bees' wax	835.6 at 80 822.1 at 98	.750
Carnaúba wax	850.0 at 90 812.2 at 93	.375
Stearic acid (commercial)	859.0 at 60 830.5 at 98	.770
Oleic acid (commercial)	903.2 at 15.5 818.4 at 99	.656
Paraffin wax	780.5 at 60 753.0 at 98	.724

* The samples of cocoa-nut and palm-nut oil were old, and had been frequently melted. Some time previously they showed densities notably less than those stated in the table. The rate of expansion of carnaúba wax requires verification, as the temperatures at which the density was taken differed by 8° C. only.

It will be observed that I have stated the densities recorded in the foregoing tables as those obtained at a temperature of 98° to 99° C. In my laboratory, water ordinarily boils at 99° C., and repeated observations have shown that oil immersed in a vessel of boiling water rarely reaches a temperature exceeding 98.5° C. This result is a confirmation of the experience of Mr. Estcourt.

Coefficients of Expansion of Oils.—It is evident that the density of a particular sample of oil being known at two different temperatures, we have the means of calculating the rate of its expansion by heat. Assuming the oils when immersed in boiling water to have had a uniform temperature of 98½° C., the difference between their density at that temperature and at 15½° is due to the expansion through 83; dividing, therefore, this difference by 83, we get a series of figures representing the mean rate of expansion of the different oils for a rise of temperature of 1° C.†. The rates of expansion for the molten fats, etc., have already been given; those for the oils fluid at ordinary temperatures are expressed in the following table. Those figures to which my name is attached are calculated from the densities already given; but I have also appended the independent results of some other observers.

NATURE OF OIL.	Correction for 1° C.	OBSERVER.
Sperm oil .. ..	.618	A. H. Allen
Bottle-nose oil .. ..	.613	"
Whale oil .. ..	.697	"
" .. ..	.722	C. M. Wetherill
Porpoise oil .. ..	.654	A. H. Allen
Seal oil .. ..	.615	"
Cod-liver oil .. ..	.616	"
Menhaden oil .. ..	.651	"
Neatsfoot oil .. ..	.625	"
Lard oil .. ..	.653	C. M. Wetherill
Olive oil .. ..	.629	C. M. Stillwell
Arachis oil .. ..	.655	A. H. Allen
Rape oil .. ..	.620	"
Sesamé oil .. ..	.624	"
Cottonseed oil .. ..	.629	"
Nigerseed oil .. ..	.637	"
Linseed oil .. ..	.649	"
Castor oil .. ..	.653	"

From an inspection of the figures recorded in this and the preceding tables it appears (1) that the rates of expansion of the fluid fixed oils are not sufficiently different to be of any value for their recognition; (2) that, of the fluid fixed oils examined, all, with the single exception of whale oil, expand sensibly equally for equal increments of heat, or at least the figures obtained do not show greater variations than would probably be observed between different samples of the same oil; (3) that, with the exception of whale oil (the high figure for which is confirmed by an independent observer), the correction in density for the

† Thus, a sample of rape oil was found to have a density of 915.0 at 15½° C., and of 863.2 at 98° C., the difference being 51.8. Dividing the last figure by 82.5, the difference between the temperatures at which the observations were made (98.0–15.5 = 82.5), the figure .628 is obtained as the correction to be made for a variation of 1° C. from the standard temperature.

fluid fixed oils mentioned in the last table may safely be taken at '64 for each degree Centigrade, or '35 for each degree Fahrenheit* ; (+) the rate of expansion of the solid fats and waxes, when in a molten state, is not ascertained with such a degree of accuracy as in the case of the oils liquid at ordinary temperatures, but in most cases is sensibly higher than that of the oils of which olein is the leading constituent, this difference extending to free stearic and oleic acids.†

It is evident that the coefficient of expansion of an oil may be deduced by dividing the temperature-correction by the density. Thus, the coefficient of expansion of olive oil will be $\frac{.646}{.916} = .000715$. This figure may be corrected for the expansion of the glass plummet if a very accurate result be desired.

Viscosity of Oils.—The determination of the viscosity of oils is a question of great practical interest, and one on which I should have liked to have entered in some detail, were it not that a paper dealing exhaustively with the whole subject is to be read before the London Section of this Society at an early date by Mr. Boverton Redwood. I shall therefore merely exhibit the new form of viscosimeter devised by Mr. Redwood, and which bids fair to become the recognised standard instrument of the future. For many purposes, however, and especially as a convenient test by oil merchants, I think an instrument on a different principle is likely to grow in favour. It consists of a simple arrangement by which a small paddle-wheel (actuated by a falling weight) is caused to revolve in the sample of oil, maintained at a definite temperature by an outer vessel of water. The manipulation is extremely simple, and the results expressed by the number of seconds required by the weight to fall through a given space are remarkably constant.‡

Bromine and Iodine Absorptions of Oils.—Dr. E. J. Mills and his coadjutors have described a method of determining the proportion of bromine absorbed by fixed oils to form bromo-additive compounds (see *Jour. Soc. Chem. Ind.* ii. 435, and iii. 366), and Baron Hübl (*Jour. Soc. Chem. Ind.* iii. 641) has investigated the percentage of iodine which various oils assimilate. The amount of halogen taken up may be considered as a measure of the unsaturated fatty acids (or their glycerides) present. Thus, the acids of the acetic or stearic series exhibit no tendency to combine with bromine or iodine under the conditions of the experiments, while the acids of the acrylic or oleic series assimilate two, and the acids of the linoleic series four atoms of the halogen. In order to facilitate comparison between the results of Mills and Hübl, I have multiplied the bromine absorptions of the former chemist by $\frac{127}{80}$, so as to obtain the equivalent

iodine absorptions, and in the following table have placed the figures so obtained in juxtaposition with the experimental numbers for iodine absorptions obtained by Hübl.

IODINE AND BROMINE ABSORPTION OF OILS.

NAME OF OIL	Mills' Bromine Absorption	$\times \frac{127}{80} =$ Iodine Absorption	Hübl's Iodine Absorption
Almond	26.3	41.8	98.4
Peach-kernel ..	25.4	40.4	—
Apricot-kernel ..	—	—	100.0
Olive-kernel ..	—	—	81.8
Olive	54.0—60.6	85.9—96.1	82.8
Earth-nut (Arachis) ..	46.2	73.3	103.0
Rape	69.4	110.4	100.0
Sesamé	47.4	75.2	106.0
Cotton-seed	50.0	79.5	106.0
Poppy-seed	56.5	89.9	136.0
Hemp-seed	—	—	113.0
Linseed (raw) ..	76.0	120.8	158.0
Linseed (boiled) ..	102.1	162.8	—
Castor	58.3	92.7	81.4
Cod-liver	83.9	133.4	—
Ling-liver	82.4	131.0	—
Shark-liver	81.4	131.2	—
Seal	57.3—59.0	91.2—95.3	—
Whale	50.9	80.9	—
Bottle-nose	48.7	77.4	—
Palm	34.8—35.4	55.3—56.3	51.5
Cocoa-nut	5.7	9.1	8.9
Cacao butter	—	—	34.0
Japan wax	1.5—2.3	2.4—3.7	1.2
Butter fat	24.5—27.9	38.9—44.1	31.0
Buttarine	36.3—39.7	57.7—63.1	55.3
Lard	37.3	59.3	59.0
Tallow	—	—	40.0
Bees' wax	0.0—0.54	0.0—0.86	—
Carnauba wax ..	33.5	53.3	—

These figures are very instructive. They indicate that the drying oils (containing linoleic acid) assimilate the largest proportions of the halogen, and their capacity in this respect might probably be employed as a measure of their drying powers. The fish-liver oils, however, fully equal the vegetable drying oils in their assimilating power for halogens. The results of Hübl may be regarded as, in the main, confirming those of Mills, but there is a striking exception in the case of almond oil, which is usually supposed to have a very similar composition to olive oil; but if Mills' figures be correct, this is clearly not the case, and almond oil must consist largely of glycerides of saturated (solid) fatty acids. Similarly, oils from peach-kernels and apricot-kernels might be expected to be of substantially similar nature; but this does not appear by the

* Thus, if a sample of oil has been found to have a density of 920.7 at 22° C., the density at 15.5° C. may be found in the following manner:—

$$\begin{array}{r} 22.0 \\ -15.5 \\ \hline 6.5 \times .61 = 4.16 \\ +920.70 \\ \hline 924.86 \end{array}$$

The establishment of the fact that the rate of expansion of the majority of fluid oils is practically identical, will greatly facilitate corrections for temperature in cases where it is not convenient to ascertain the density at exactly the standard point.

† Owing to the enormous contraction undergone by many waxes and fats in the act of solidification, in the solid state they are considerably denser than the fluid fixed oils. Thus, solid beeswax is as dense as castor oil, but in the molten state it is much lighter.

‡ The apparatus has passed through several stages of development at the hands of the inventors.

table. On the other hand, even in non-drying oils, like olive, which are presumably free from glycerides of the linoleic series, the proportion of olein corresponding to the halogen assimilated, exceeds 100 per cent., a fact which suggests that the methods of operating adopted have not entirely prevented the formation of bromo- or iodo-substitution products, though Mills obtained, with purified triolein, and Hübl with pure oleic acid, results closely in accordance with theory. Hübl's figure for cacao butter indicates that this fat is not approximately pure stearin, as commonly represented. The low figures of both Mills and Hübl for Japan "wax" are remarkable, as also the difference between the absorptions of carnauba and beeswax. Mr. Reginald Moore has obtained figures for the iodine-absorptions of oils which agree closely with those of Hübl, whose process he strongly recommends.

Valenta's Acetic Acid Test.—The behaviour of various fixed oils with glacial acetic acid has been recently investigated by E. Valenta (*Dingl. Polyt. J. cclii.* 296; *Journ. Chem. Soc.* xlvii. 1078). Equal "parts" of the oil and of glacial acetic acid of 1056·2 specific gravity are mixed,* and gradually heated, with continuous shaking, until complete solution takes place, or the acid begins to boil. A thermometer is then immersed in the liquid, the tube allowed to cool slowly, and the temperature recorded at which the liquid becomes turbid. I have tried this test on a number of oils, and find a slight variation in the strength or proportion of the acid employed is not of importance, and that the temperature at which turbidity occurs with any particular specimen is readily observed and fairly constant. Unfortunately my experience is not in accord with that of Valenta as to the turbidity-temperatures of particular oils, a fact that renders it probable that different specimens of the same description of oil give results showing considerable variations. The discordant figures obtained by Valenta and me for palm oil are probably due to the different proportions of free acid in the samples; and the same explanation may account for Valenta's figures for green and yellow olive oil.

The table on next column shows the results both of Valenta and myself.

From an inspection of the table, it would appear that olein is only with difficulty soluble in glacial acetic acid, and that the same is true of stearin. The discrepancy between the figures for the turbidity-temperature of palm oil makes the solubility of palmitin uncertain; but it is evident that the glycerides of fatty acids lower than palmitic (as contained in porpoise oil, butter fat, cocoa-nut oil, laurel oil, nutmeg butter, etc.), dissolve with comparative facility. I have obtained remarkably constant results from several samples of butter, and it appears probable that further experience may prove the method to afford a simple means of distinguishing butter from butterine. The incomplete solubility of rape oil and other oils, from the *cruciferae*, even at the boiling-point of acetic acid, is noteworthy, as are the low figures found for linseed oil, niger-seed oil, and menhaden oil, as compared with those for the non-drying oils.

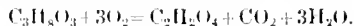
Valenta has also proposed to employ glacial acetic acid at 50° C. for distinguishing mineral oils from rosin oils, the former being sparingly, and the latter readily, soluble in that reagent.

Determination of Glycerin.—The determination of the glycerin produced by the saponification of fixed oils was, till recently, a very unsatisfactory and uncertain operation, chiefly owing to the loss of

Kind of Oil.	Temperature of Turbidity, °C.	Observer.
Green Olive Oil	85	Valenta
Yellow " " " " ..	111	"
Almond Oil .. " " ..	110	"
Arachis Oil .. " " ..	112	"
" " " " " " " "	87	Allen
Apricot-kernel Oil ..	114	Valenta
Neatsfoot Oil .. " " ..	102	Allen
Sesamé Oil .. " " ..	87	"
" " " " " " " "	107	Valenta
Melon-seed Oil .. " "	108	"
—		
Cotton-seed Oil .. " "	110	Valenta
—		
Niger-seed Oil .. " "	49	Allen
Linseed Oil .. " " ..	57	"
—		
Menhaden Oil .. " "	61	Allen
Cod-liver Oil .. " "	101	Valenta
" " " " " " " "	79	Allen
Shark-liver Oil .. " "	105	"
—		
Rape-seed Oil .. " "	Not completely dissolved at the boiling point of acetic acid.	Valenta
Mustard-seed Oil ..		"
Wild Radish-seed Oil		"
Whale Oil .. " "		Allen
Sperm Oil .. " "		"
—		
Palm Oil .. " " " "	23	Valenta
Laurel Oil .. " " " "	26–27	"
Nutmeg Butter .. " "	27	"
Cocoa-nut Oil .. " "	40	"
Palm-nut Oil .. " "	48	"
Bassia Oil .. " " " "	64·5	
Butter Fat .. " " " "	61·5	Allen
Porpoise Oil .. " " "	40	"
—		
Palm Oil .. " " " "	83	Allen
Butterine .. " " " "	98	"
Lard .. " " " " " "	96·5	"
Beef Tallow .. " " " "	95	Valenta
Pressed Tallow .. " "	114	"
Cacao Butter .. " " "	105	"
—		
—		
Olive-kernel Oil ..	Completely soluble at the ordinary temperature.	Valenta
Castor Oil .. " "		
Colophony .. " "		Allen
—		
Stearic Acid (Commercial)	36	"
Oleic Acid (Commercial) ..	27	"

* See. of the sample of oil, previously melted, if necessary, at a gentle heat, and an equal measure of glacial acetic acid are convenient quantities to employ.

glycerin by volatilisation. The problem has, however, been recently solved in a fairly satisfactory manner by the employment of a process originally suggested by Mr. J. A. Wanklyn, further worked out by Mr. W. Fox, and perfected by Benedikt and Zsigmondy (*Chem. Zeit.* ix. 975; *Jour. Soc. Chem. Ind.* iv. 610). The method depends on the saponification of the oil, and oxidation of the resultant glycerin by permanganate in alkaline solution, with formation of oxalic acid, carbon dioxide, and water, in accordance with the following equation—



The excess of permanganate is then destroyed by a sulphite, the liquid filtered from the oxide of manganese, the filtrate acidulated with acetic acid, and precipitated by a calcium salt. The precipitate consists of calcium oxalate mixed with more or less sulphate, silica, etc., and hence cannot be directly weighed. It may either be ignited, and the amount of oxalate previously existing deduced from the volume of standard acid required for the neutralisation of the residue, or the precipitate may be treated with dilute sulphuric acid, and titrated with standard solution of permanganate. A direct titration of the acidulated filtrate from the manganese precipitate, even when the use of an excess of sulphite has been carefully avoided, has been proved by a number of experiments made in my laboratory by Mr. J. C. Belcher, to give results in excess of the truth, apparently in consequence of the formation of a dithionate. When, however, the process is completed in the manner recommended by Benedikt very satisfactory results are obtained. The accuracy of the process has been fully confirmed in my laboratory by experiments on known quantities of oxalic acid and glycerin.

When, however, the method is employed for determining the glycerin produced by the saponification of oils, a serious practical difficulty arises. Ordinary (ethylic) alcohol yields a considerable, though variable, proportion of oxalic acid by oxidation, and if, as recommended by Wanklyn and Fox, alcoholic potash be employed for effecting saponification, it becomes practically impossible to eliminate all trace of alcohol by evaporation without incurring or risking the loss of an appreciable quantity of glycerin. To avoid this difficulty, Benedikt and Zsigmondy employ "pure methyl alcohol." In my experience, the article obtainable under this name in commerce yields a very appreciable quantity of oxalic acid when evaporated with caustic alkali, and the residue oxidised with permanganate. In my laboratory, the preparation of methyl alcohol which will stand this test has proved so troublesome as practically to negative its employment; and hence I have latterly aimed at effecting saponification by aqueous alkali, and thus completely avoiding the source of error in question. Complete saponification in an aqueous liquid is, however, not easy to effect with certainty,* and it was only after numerous failures that I succeeded in hitting on such a mode of procedure as appears to ensure complete saponification with a minimum of manipulation. In my experience, the best results are obtained by placing 5grms. of the

sample of fixed oil in a six-ounce bottle, together with a solution of 2grms. of good caustic potash in 12cc. of water. The bottle is securely closed and heated in a water-oven, or in boiling water, for eight or ten hours, the contents being frequently agitated.† When the product is perfectly homogeneous, and all oily globules have disappeared, the bottle may be opened, and the soap diluted with hot water, when a perfectly clear solution should be obtained, except in the case of sperm oil, waxes, and other bodies yielding insoluble alcohols on saponification. The soap solution is then treated with a moderate excess of acid in the usual way, and the liberated fatty acids separated from the aqueous liquid containing the glycerin, which latter is then ready for oxidation with alkaline permanganate in the manner already described.

The following table gives the percentages of glycerin yielded by the saponification of various fixed oils and fats, as ascertained by the permanganate process. The figures marked with an asterisk were obtained by the use of methyl alcohol, which experiment subsequently showed was not of satisfactory purity. Hence these results are probably somewhat in excess of the truth. The rest of my results are rather below than above the truth, and were obtained by saponification with aqueous potash, while Benedikt and Zsigmondy used methyl alcohol. Fox and Wanklyn recommend ethyl alcohol, but have not published any figures.

Kind of Oil.	GLYCEROL, per Cent.	
	Benedikt.	Allen.
Doegling (Bottle-nose) Oil ..		3.10*
Northern Whale Oil		11.96
Porpoise Oil		11.09
Menhaden Oil		11.10
—		
Lard		10.83
Tallow	9.94—9.98	
Butter Fat	10.21—11.39	11.06
—		
Olive Oil	10.15—10.38	
Rape Oil		9.82*
Sesamé Oil.. .. .		9.94*
Linseed Oil	9.15—9.97	9.39
Castor Oil		9.03—9.13
—		
Oat Fat		8.35
Cocoa-nut Oil	13.3—14.5	12.11
Palm-nut Oil		11.70
Palm Oil		9.71
—		
Bees' Wax.. .. .	none.	

It is interesting to compare these figures with those obtained by M. Chevreul, given in his classical *Recherches Chimiques sur Les Corps Gras d'origine animale*, published in 1823. His glycerin was extracted and weighed as such after being purified by

* It is a fact not generally known that the saponification of fats on a larger scale by the "autoclave" process, which consists in heating the substance with water and a base under a pressure of 8 to 12 atmospheres, is often very incomplete. Olein is more difficult to saponify than is stearin or palmitin, and hence, when the product is subjected to pressure, the solid fatty acids are almost free from neutral fats; but the oleic acid is apt to contain a considerable proportion of unaltered glycerides.

† No practical advantage is gained by effecting the saponification under increased pressure in a sealed tube.

alcohol, dried in a vacuum, and the ash left on igniting it deducted from the gross weight found. His results are doubtless low, owing to unavoidable volatilisation during the concentration of the aqueous liquid.

PRODUCTS OF SAPONIFICATION OF ANIMAL FATS—
CHEVREUL.

Fat.	Glycerin.	Non-volatile Fatty Acids.	Ba Salts of Volatile Fatty Acids.
Human	9'66	96'18	trace.
Pork	8'82	95'90	trace.
Beef.....	8'60	96'00	trace.
Mutton	8'00	96'50	30
Butter	11'85	88'50	5'0*
Porpoise Oil ..	11'00	82'20	16'0†

From these tables it appears that the proportions of glycerin yielded by the majority of fixed oils confirm the generally accepted views of their constitution. The case of butter fat is especially interesting, as the results negative the theory of Wanklyn and Fox, that butter contains a notable proportion of *isoglycerides*, and that the butyric acid obtained on saponifying it is really derived from the splitting up of the resultant isoglycerin into a fatty acid and water :



The result yielded by oat-fat, which was prepared in my laboratory by exhausting oat-meal with ether, refutes the statement of König, who could obtain no glycerin by saponifying oat-fat, and but little from linseed oil. The high proportion of glycerin obtained from cocoa-nut oil, fully bears out anticipations founded on the knowledge that it consists largely of glyceryl trilaurate, and contradicts the extraordinary statements of Hammerbocker and Lehmann that cocoa-nut oil consists chiefly of free fatty acids. I propose to consider further the results obtained by Benedikt's process, together with others which have grown out of them, in a future paper.

DISCUSSION.

The CHAIRMAN said that the meeting had listened to Mr. Allen's paper with great interest, and they were all struck by the ingenuity of the appliances exhibited by him for testing the viscosity of oils. He hoped to hear remarks from the various public analysts present on the application of Westphal's hydrostatic balance in the determination of the specific gravity of fats and oils.

Mr. THOMSON said that one disadvantage of taking specific gravities with Sprengel's tubes was that one could not introduce a thermometer into them to ascertain whether the liquid inside had the same temperature as the bath. He had himself obtained good results by using a very simple apparatus, devised, he thought, originally by Prof. Thorp and Mr. Hannay. A piece of glass tubing was drawn out at either end into fine tubes, and in the centre was blown into a sort of elongated bulb. One end was then bent upwards until that which had resembled a pipette assumed the shape of a U-tube. The same end was again bent outwards above the level of the bulb to

form a sort of spout. The other end, which was left straight, was then marked with a scratch a little below the level of the outward bend on the crooked tube. The whole was then heated in a paraffin bath, in which it was immersed, to within a quarter-of-an-inch of the top. In the same or a similar bath was a test tube containing the fat or oil, the specific gravity of which was to be determined. When the required temperature was reached, the operator took out the U-tube, and drew in through the spout sufficient oil from the test tube to fill the apparatus up to the mark. Further entrance of oil was then stopped, closing the orifice with the finger. The whole was then carefully wiped and weighed. As regarded Westphal's balance, it certainly gave equally accurate results as the specific gravity bottle, and with less trouble. As to Fox and Wanklyn's method of glycerin estimation, he would be glad to know if the author took into account any free acid which might exist in the samples which he examined. Perhaps he would also state whether he found any difficulty in cleaning the paddles of his viscosity-apparatus.

Mr. J. CARTER BELL said that he had used an apparatus for some years, similar to that exhibited by the author, for taking specific gravities of butter and other fats. He was not sure that the latest modification made by Mr. Allen was an improvement, as the agitation of the water would cause the tube to leave the perpendicular. With paraffin one had a constant level, which was not the case with water. Would not the steam also affect the balance?

Mr. ESTCOURT was sorry that the title of Mr. Allen's paper had given no idea that he would enter so fully into the question of taking specific gravities at high temperatures with the Westphal balance, for he (Mr. Estcourt) could have shown the meeting the instrument originally made for him by Westphal, with the bath he had himself devised some nine years back, for taking the specific gravities of butter at or near 212° F. (see *Chemical News*, vol. xxxiv. p. 254; *Ib.* vol. xxxviii. p. 267). Since that time he had used the balance largely for milk, spirits, and other liquids; and for butter he knew no instrument that could replace it. He had then tried it for the thicker or viscous oils with equally good results. It was at his suggestion that the author had adopted the same system; and much credit was due to him for the way in which he had extended its use. As regarded the use of water as the immediate source of heat, it was no special improvement, though the device of the indiarubber ring certainly prevented any steam reaching the beam of the balance.

Mr. GRIMSHAW said that methyl alcohol was now being produced in an almost perfect state of purity. He would refer the author to Mr. Fawsitt's paper, read before the Glasgow Section (see this *Journal*, vol. iv. p. 319).

Mr. C. RAWSON (of Bradford) suggested that the difficulty experienced in accurately estimating glycerine by converting it into oxalic acid, would probably be overcome by adding a large amount of water, and then boiling the solution of soap and glycerine down to a small bulk.

Mr. ALLEN said that the only essential difference between the apparatus used by him, and that devised by Mr. Estcourt, for determining the densities of fats at the boiling-point of water, was the omission by him of the intermediate bath of paraffin. He had not the least objection to Mr. Estcourt's contrivance, except that he thought it unnecessary. He was not surprised to learn that Mr. Bell had habitually used the hydrostatic balance for the general purposes of the laboratory, as it was contrived by Westphal with that object; but he hoped to see the instrument more

* Equal to 2'83% of butyric acid.

† Equal to 9'63% of valeric acid.

frequently employed in future than had been the case hitherto.

As to the impurity in commercial methyl alcohol, which interfered with its employment for the determination of glycerine, he might point out that in an ordinary estimation, about 30cc.—say 25grms.—of the reagent was employed. If this contained even 1 per cent. (= 0.25grms.) of an impurity—which he presumed to be acetone or an allied body, which would yield oxalic acid by the subsequent treatment—it would be fatal to the accuracy of the process; as the amount of glycerin to be determined did not exceed 0.5grm. As to ethyl alcohol, that itself yielded oxalic acid by oxidation; and test experiments, in which alcohol was evaporated with caustic alkali, and the residue oxidised with permanganate, showed that it was not possible in practice to avoid the formation of oxalic acid without risking the loss of glycerine. In the saponification with aqueous alkali, evaporation was entirely dispensed with; but it would undoubtedly be a great advantage if methyl alcohol fit for the purpose could be procured, or prepared with reasonable facility.

It might interest the meeting to know that M. Chevreul, who had recently celebrated his hundredth birthday, in a reply to a communication from Mr Allen, stated his intention to revise and complete his researches on fats, after which he proposed to devote his spare time to the neglected correspondence of the last fifty to sixty years.



Meeting held January 5, 1886.

MR. LEVINSTEIN IN THE CHAIR.

ON THE EXAMINATION AND ANALYSIS OF CERTAIN MATERIALS USED IN DYEING AND CALICO PRINTING.

BY ROWLAND WILLIAMS, F.C.S.

THE subject which I am about to bring before you this evening is, I think, one of considerable importance to a section of a Society like ours, composed as it is of scientific and practical chemists, bleachers, dyers, calico-printers, and other persons engaged in, or more or less connected with, chemistry in its various applications.

The comparatively short space of time at my disposal will not permit me to cover so much ground as I should like to do, and I shall, therefore, confine myself to a few of the more important substances employed in dyeing and calico-printing.

I propose to give my experience of some of the methods generally employed in the examination of these dyewares, and at the same time to suggest occasional modifications, which I have found useful, and which may, perhaps, also be of value to others engaged in the testing of similar materials.

First, I will call your attention to that very important substance, *Alizarin*. Artificial alizarin is generally met with in commerce as a paste, containing 10, 15, or 20 per cent. solid matter, which, in many cases, is not pure alizarin, but a mixture of that substance with various proportions of anthra-purpurin, flavo-purpurin, etc.

With alumina mordants, pure alizarin yields red shades inclining to blue, whilst the presence of anthra-purpurin and flavo-purpurin modifies the shade considerably, the former giving a purer red, whilst the latter tends to produce a yellowish tint. Perhaps the

most satisfactory method for the examination of alizarin is to make a practical test in dyeing, or printing, or both, and observe the shade produced, after steaming and soaping.

In many cases it is useful to take the specific gravity, and to estimate the total solid matter, and afterwards to ignite the latter, when only a slight residue should remain, if the alizarin be fairly pure. In good makes of alizarin I have generally found the specific gravity and total solid matter to have a close connection with the shades produced in dyeing and printing.

In badly prepared alizarin, minute reddish brown specks are sometimes found, and a careful search should be instituted for these, as they are liable to cause uneven, freckly shades, especially when the alizarin is used for printing.

Starches should always be specially examined for grit, by mixing into a thin paste with cold water on a porcelain slab, and feeling very carefully with a spatula, or with the finger, for any traces of gritty matter which may be present. I may say, in passing, that freedom from grit of the various materials employed in calico-printing cannot be too highly insisted upon. If grit be present in the starches and other substances used in making colours, it is certain to be found in the colours when ready for printing, as no amount of straining—even through the finest straining cloth—will entirely remove this finely divided gritty matter, which is the cause of so much damaged work. A paste should also be prepared by boiling a portion of the sample, and compared in respect to colour, consistency, etc., with a paste made from a standard sample of starch. Up to the present time no very accurate method has, I believe, been devised for determining the consistency or body of starch paste. The plan, which is sometimes adopted, of noting the weight which a paste will bear without breaking, is not satisfactory; and perhaps as good a way as any to form a judgment on the consistency of starch paste is by careful pressure with the finger. Moisture and ash should be determined in the usual manner, and a microscopical examination of the sample should also be made.

Bichromate of potash is largely used in dyeing and calico-printing for the production of chrome yellows, and for other purposes. Owing to the comparatively high price of potassium bichromate, attempts have, for some time past, been made to replace it by the cheaper soda salt. The desired result has at length been attained; and bichromate of soda is now employed in large quantities by dyers and calico-printers, instead of the corresponding potassium salt. It has been asserted that potassium bichromate produces brighter yellows than sodium bichromate, but my experience does not confirm this statement. I have here several printed samples of various designs, certain parts of which have been prepared with acetate of lead, and then raised by passing through baths of bichromate of soda and potash of equal strength. On examination of these patterns, I think you will admit that those raised by means of sodium bichromate are equal in every respect to those in which potassium bichromate has been employed. Commercial bichromate of soda is made so as to contain about the same percentage of chromic acid (the valuable constituent) as bichromate of potash, and as the former costs a penny per lb. less than the latter, it will at once be seen that an enormous saving must result from the employment of the soda compound. Bichromate of soda possesses the additional advantage over bichromate of potash, that it dissolves much more readily in water, often saving valuable time when work is urgent. The estimation of the chromic acid in bichromates is best performed by a known

excess of pure ferrous sulphate or ferrous ammonium sulphate to a fairly strong solution of the sample in water acidified with sulphuric acid. The excess of iron existing as protoxide is then determined by means of standard bichromate solution.

Alum and Sulphate of Alumina.—It is advisable to test for free acid in these substances, and this is best done by means of a dilute solution of the colour known as Congo red, which is changed to a beautiful blue by the slightest trace of free acid, whilst it is not affected by alumina itself, provided the Congo red solution be sufficiently dilute. The amount of free acid present in sulphate of alumina is usually determined by leaving a weighed quantity of the finely powdered sample in contact with strong alcohol overnight. The alcohol is then filtered off, and the sulphate of alumina washed several times with strong alcohol. The alcoholic filtrate is then diluted with water, and concentrated on the water-bath until the odour of the alcohol has entirely disappeared, and the residue is of syrupy consistency. This is then treated with absolute alcohol, which throws out of solution most of the alumina which may have been dissolved during the earlier stages of the process. The liquid is filtered through a small filter, which is afterwards washed with absolute alcohol. The alcoholic filtrate is then diluted with water, and titrated with standard caustic soda, using phenolphthalein as indicator. I have endeavoured to devise a colorimetric process for the direct estimation of the free acid in alum cake and in similar substances, by comparing the depth of colour produced by adding Congo red solution to an aqueous solution of the sample, with that obtained in a similar manner from a very dilute acid liquid of known strength. So far, however, my results have not been very satisfactory; but I hope shortly to overcome the difficulties connected with the process, which would, if reliable, be very convenient for those who have to make a large number of analyses of this description.

Red Liquor should be submitted to a practical test by mordanting a piece of cloth with the sample, and, after ageing, etc., dyeing up with alizarin. In addition, it is often necessary to determine the amounts of acetic acid and alumina present. The acetic acid is best estimated by distillation with pure phosphoric acid, and titration of the acid distillate with standard caustic soda solution. With regard to the estimation of the alumina, it may, perhaps, seem almost unnecessary to warn chemists of the inaccuracy of the results which would be obtained by precipitating the alumina directly from the diluted red liquor, and yet I have known serious errors to arise from this cause. Usually the results obtained by direct precipitation are too low, owing to the presence of organic matter, but I have occasionally met with samples which, when precipitated directly, have indicated about 1 per cent. of alumina above the amount actually present. The method which I have found to give the best results is to evaporate a weighed quantity of the red liquor to dryness in a platinum vessel, ignite the residue, dissolve in hydrochloric acid, filter, and precipitate the alumina in the filtrate with a slight excess of ammonia. The alumina precipitate is then filtered off, washed, dried, and ignited in the usual manner. It is not necessary to ignite the residue from the evaporated red liquor to perfect whiteness; in fact, I find it a disadvantage to do so, as strongly ignited alumina is only soluble in hydrochloric acid with difficulty, thus occasioning loss of time. I append the following results, which were obtained in my laboratory by determining the alumina in three samples of red liquor, (1) by direct precipitation, (2) by precipitation after partial ignition, (3) by precipitation after complete ignition.

Sample No.	Direct.	Alumina.—Per Cent.		
		Partial.	Complete.	Complete.
Sample No. 1	2.19	2.41	2.40	2.40
Sample No. 2	3.01	3.18	3.20	3.20
Sample No. 3	3.31	3.42	3.45	3.45

From the above it will be seen that practically the same results were obtained whether the residue was only partially or whether it was completely ignited, but that the figures found by direct precipitation vary considerably from the actual percentages of alumina present.

Bleaching Powder.—In connection with the testing of this substance, I may mention a slight modification of my own of the ordinary process for the estimation of available chlorine, which has proved very useful when I have had several samples of bleaching powder in my laboratory at the same time. As is well known, the usual plan is to weigh out 10grms. of the bleaching powder, grind this in a mortar with successive quantities of water, and finally make up to a litre. Measured quantities of this are then taken for titration, usually with sodium arsenite, or ferrous sulphate solution, in order to estimate its oxidising power. My method of procedure is to weigh out two small quantities of each sample, say 5 or 6 grains, from a stoppered weighing tube, into flasks of 10 or 12oz. capacity, treat each with about 1000 grains of water, and then shake each flask thoroughly. I then add an excess of decinormal sodium arsenite solution to each, and after mixing well I add a little starch solution, and run in decinormal iodine solution until the blue colour appears. The calculations are then easily made. I find this modified method gives results practically identical with those obtained by the usual process, and it possesses the decided advantage that duplicate estimations can be made by it in as short a time as is required for a single determination by the ordinary process.

Glycerine.—In addition to the tests mentioned in various works on this subject, I would also suggest that of ascertaining the amount of arsenic which the sample will dissolve, as this is one of the principal uses of glycerine in many print works. The experiment may be made by heating together for some time a weighed quantity of glycerine and a known excess of arsenious acid. The solution is then diluted with water, filtered through a tared filter, the residue thoroughly washed, dried, and then weighed. The quantity of arsenic dissolved by the glycerine is then readily ascertained by subtracting the weight of the residue from the amount of arsenious acid originally taken. If desired, the arsenic in solution may also be estimated in the filtrate by means of standard iodine solution. Good glycerine should dissolve about 6lb. arsenic to the gallon.

Oleine.—The substance which is sold to dyers and printers as oleine, is usually a compound of sulpho-ricinoleic acid, with soda, potash, or ammonia. The best process for the estimation of the fatty acids is that mentioned in Allen's "Organic Analysis," which consists in weighing out 10grms. of the sample, and heating with 25grms. white wax and 75cc. of a cold saturated solution of common salt, in which the liberated fatty acids are practically insoluble. When cold, the resultant cake should be dried as completely as possible with a little bibulous paper, and then heated gently until every trace of water is dissipated. The final gentle heating of the fatty acids should never be omitted, or the results will certainly be too high, owing to the fatty mass occluding a certain amount of water. I find that what may be termed the "ether process" does not yield trustworthy results, owing to the ethereal extract being contaminated with water and with mineral matter (usually sulphate of soda), which have not been completely removed in the earlier stages of the analysis. The "ether process"

sometimes gives results two or three per cent. higher than the "salting-out process." The following results were obtained from a sample of oleine, which had been carefully prepared in my laboratory so as to contain 50 per cent fatty acids:—

Fatty acids	Ether process.	Salting-out process.
	52.82.	50.12.

These figures show very clearly that much more accurate results are obtainable by the "salting-out process" than by the "ether process."

Tartar Emetic.—The most accurate method for the estimation of antimony in tartar emetic is by precipitation as sulphide from an acid solution by means of sulphuretted hydrogen gas. Quite satisfactory results may, however, be obtained by the ordinary process, in which the oxidation of the antimonious acid into antimonie acid is effected by iodine in alkaline solution. Whilst on the subject of tartar emetic I should like to say a few words about its substitute—viz., antimony potassium oxalate. As is well known, there is considerable difference of opinion among the various authorities with regard to the respective values of the tartrate and oxalate of antimony and potassium. Now, as the tartrate usually contains at least half as much antimony again as the oxalate, one would naturally expect the former to give correspondingly better results than the latter, but this is not the case. On the contrary, I have found, from experiments made in my laboratory, that in piece and yarn dyeing better results are in many cases obtained with the oxalate than with the tartrate, even when equal weights of each are employed, although the former only contains about two-thirds the quantity of antimony present in the latter. This peculiar result is, without doubt, as Dr. Witt has suggested, due to the fact that the oxalate dissociates more easily than the tartrate, and, consequently, fixes the tannic acid more readily and more completely in the fibre. In order to prove to you the more rapid dissociation of the oxalate of antimony and potassium, I have placed in one of these beakers a solution of that compound, and in the other a solution of tartar emetic, both of the same strength—viz., 10grms. per litre. On addition of equal quantities of this tannic acid solution to each beaker, you will observe that in the case of the oxalate the precipitate appears immediately, and soon settles to the bottom, whilst in the tartar emetic the precipitate takes a considerably longer time to form. I have here samples of cloth and yarn which have been steeped in tannic acid solution, and then passed through baths containing respectively 5, 7½, 10, and 20grms. per litre of the tartrate and oxalate. The cloth was then dyed up with methyl green, one part of the yarn with methylene blue, and the other part with malachite green. In the case of the cloth comparatively little difference can be detected between the respective pieces, but the results obtained with the yarn, especially that dyed with methylene blue, are very striking. It will be seen on examination of these dyed samples that in every case, with the exception of the strongest (20grms. per litre) bath, the oxalate has given the better results of the two. This latter result confirms M. Nölting's statement that "oxalate baths too concentrated do not act so well as more dilute baths." The best result was obtained by using an oxalate bath containing 10grms. per litre, this being found to act more satisfactorily even than the tartrate bath (20grms. per litre), notwithstanding the fact that the latter contained three times as much antimony as the former. I have not had any practical experience in the use of the oxalate for fixing complicated printed patterns, but I am informed by the manager of one of the largest printworks in this

neighbourhood, that, for every style, it may be substituted for tartar emetic with perfectly satisfactory results.

DISCUSSION.

The CHAIRMAN said that the author appeared to him to be too sure that antimony oxalate did replace tartar emetic weight for weight. Had he read an account of the recent investigations of Drs. Lauber and Boetsch, which unfortunately added to the already too conflicting evidence on the subject? Without wishing to forestall the report of the Committee formed to investigate the comparative values of these substances, he might go so far as to say that antimony oxalate did not appear in all cases to be an economical substitute for tartar emetic, or even universally applicable. The use of Congo red as an indicator of acidity had already been alluded to some months since in some of the German papers.

Mr. A. H. ALLEN said one statement of Mr. Williams, in connection with the assay of "soluble oil," appeared to him a remarkable one, as it practically amounted to an experience that sodium sulphate was withdrawn from an aqueous solution by agitation with ether. He would ask whether the usual precaution was taken of agitating the ethereal liquid with fresh water after separating it from the aqueous layer. Some commercial ether contained from 12 to 15 per cent. of alcohol, the presence of which gave it a tendency to dissolve some saline matter, though sodium sulphate would not be among these. The alcohol could be removed by several agitations with water, and the ether dried by digestion over sodium.

Mr. WATSON SMITH, in reference to the question of impure alizarin pastes, said that modern Turkey-red dyers and printers preferred pastes containing *pure* flavo-, or anthra-purpurin, which they could mix themselves if necessary. Such pastes could now be readily obtained, and any desired shade could be had by judicious admixture of the pure ingredients. He had tried the "Congo red" test and had found it answer well. In Spence's alum works they regularly used a test based on the decolorisation of yellow solution of ferric acetate by solution of alum containing free acid. This gave good results by daylight, but by gas-light he should prefer the "Congo red."

He considered Mr. W. B. Hart's method of testing tartar emetic (see Journal, vol. iii. p. 294) to be the best for speed and accuracy. Mr. Tyrer, whose firm manufactured this article, had also reported very favourably of it.

Mr. THOMPSON had not been so successful as the previous speaker with the Congo red test. Having ground up some potash alum and washed it thoroughly with alcohol, he dissolved it in water and applied the test, when the solution became blue. Perhaps he had failed to eliminate every trace of free acid, for certainly a very small quantity of acid sufficed to render the solution deep blue. Perhaps the author would tell them whether he had been able to prepare a sample so free from acid as not to affect the red colour. As regards the comparative samples of dyed yarn exhibited, those treated with antimony oxalate were certainly superior. Perhaps the Chairman, who had taken a special interest in the question, would tell them how there could be any longer doubt as to which salt of antimony was the more economical mordant.

Mr. C. RAWSON said that he had made comparative tests both in the laboratory and the dyehouse on the use of sodium and potassium bichromates as mordants. He had found that in those cases of wool-dyeing where the mordant was applied previous to the dye-stuff, pure sodium bichromate gave equally

good results as the potassium salt. But in the dyeing of *fast browns* by the so-called "saddening method" (where the mordant was applied after dyeing) potassium bichromate invariably gave better results. With *sodium* bichromate as the mordant, a greater weight of the dyewoods was required to produce a given shade than when *potassium* bichromate was used as the "saddening" agent. Although the active principle in each salt was the same—viz., chromic acid—it might be that the nature of the *bases* played an important part in the "saddening" process.

Mr. HEYWOOD had also found sodium bichromate not quite so satisfactory as bichromate of potassium for dyeing "catechu browns," but it was a long while since, and probably the salt was impure.

Mr. POTTER, as the original maker of bichromate of soda in this country, was glad to hear, from the remarks of the various speakers, that the prejudice against use of this salt was now dying out.

Mr. WILLIAMS: In reply to Mr. Allen's question as to the reason why the ethereal extract might not be washed with water in the estimation of fatty acids in oleine by the "ether process," I may point out that, inasmuch as sulphoricinoleic and other sulphonic acids contained in oleine are soluble in water to a considerable extent, the results would be much below the truth if this plan were adopted. To prove that such is the case, I may mention an experiment which I made with the sample of oleine previously referred to. When the ethereal extract was not washed, I obtained nearly 53 per cent. fatty acids instead of 50 per cent. actually present; but when the ethereal solution was washed two or three times with water, I only obtained about 45 per cent. fatty acids.

Mr. Watson Smith is correct in asserting that commercial alizarin may be obtained almost pure *if desired*. Pure alizarin, however, as I stated at the commencement of my paper, yields reds inclining to blue, whereas it is sometimes necessary to produce pure reds, and at other times reds with a yellowish east. In order to meet these requirements for full reds, a certain proportion of anthra-purpurin is mixed with the alizarin of commerce, whilst for yellow shades of red a little flavo-purpurin is introduced.

With reference to the ferric acetate test for free acid in alum, I have often tried it, but have generally found it unsatisfactory, and I can strongly recommend the Congo-red test in preference. I have also tried Mr. W. B. Hart's modified method for the estimation of antimony tartar emetic, but fail to find it any advantage over the ordinary process.

In reply to Mr. Thomson, I have no doubt that he did not wash away every trace of free acid from the alum with which he experimented, otherwise he would have obtained no blue colour with Congo-red solution, which, as I stated before, if sufficiently dilute, has no action on alum itself.

The results of my experiments confirm Mr. Heywood's experience in the use of antimony potassium oxalate, which he finds to give better results than tartar emetic in uni-colour dyeing. With regard to its applicability for fixing complicated printed patterns, the manager of a very large printworks near Manchester, where a great variety of work is done, informed me a few days ago that they had been using the oxalate for the last three months, and that it gave every satisfaction.

As Mr. Allen has suggested, the exceedingly contradictory results on this point which have been obtained by various persons, may possibly be accounted for by the samples with which they experimented having been largely contaminated with sulphate of potash or with other adulterants.

Meeting held Tuesday, 2nd February.

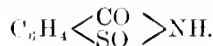
MR. WATSON SMITH IN THE CHAIR.

ON SACCHARINE—A NEW SWEETENING AGENT DERIVED FROM COAL TAR.

BY IVAN LEVINSTEIN.

I AM desirous of bringing under your notice this evening a substance which, known for the last few years only to specialists as a chemical curiosity* on account of the difficulty of its production, is likely, in consequence of further improvements by its discoverer in the process of manufacture, to enter the market as a commercial product.

Modern chemistry has achieved a new triumph—one, indeed, the commercial importance of which cannot yet be fully realised. From the black viscous liquid, gas tar, has been prepared, an article which seems likely to enter into daily consumption. We have scarcely as yet become fully familiar with the ever-increasing number of coal-tar dyes, with the production of aromatic substances and those possessing powerful antiseptic and medicinal properties from the same prolific source, when the fresh and startling announcement is made that, by a novel treatment of one of the components of coal tar, a compound may be obtained possessing very similar sweetening properties—but in a far more intense degree—to the best cane or beetroot sugar. The commercial name given to this singular substance by its discoverer, C. Fahlberg, a German chemist residing in the United States, is "saccharine." It is not my intention this evening to diverge into any speculations as to the probable economic effects of this wonderful discovery, great as the temptation may be; I shall confine myself to a brief description of the mode of production, and the general and physiological properties of saccharine, and I will also give you an opportunity of inspecting the substance itself and some of its compounds. The chemical name of saccharine is benzoyl sulphonic imide, and it may be expressed by the chemical formula



In order to obtain saccharine, Fahlberg† commences with toluene, a hydrocarbon present, as you are probably all aware, in coal tar. This toluene C_6H_5 (CH_3) he converts into its two monosulphonic acids



and transforms these by treating them with phosphorus-pentachloride (PCl_5) into the corresponding toluene-sulphonic chlorides



Of these two toluene-sulphonic chlorides—viz., the para and the ortho—only the ortho compound, which is liquid (the other being solid), is suitable for the production of saccharine. By the introduction of the amido group of ammonia, this ortho-toluene-sulphonic chloride is then converted into ortho-toluene-sulphanide



which finally yields, by oxidation, the benzoyl sulphonic imide or saccharine.

* American Chemical Journal, vol. 1, page 170; and vol. 2, page 181, and fol. I, page 425.

† Eng. Pat. 6626, June 1, 1885; specification of James Yate Johnson. This Journal, iv. p. 608.

Saccharine presents the appearance of a white powder, and crystallises from its aqueous solution in thick short prisms, which are with difficulty soluble in cold water, but more easily in warm. Alcohol,* ether, glucose, glycerol, etc., are good solvents of saccharine. It melts at 200° C., with partial decomposition; its taste in diluted solutions is intensely sweet, so much so that one part will give a very sweet taste to 10,000 parts of water. Saccharine forms salts, all of which possess a powerful saccharine taste; it is endowed with moderately strong antiseptic properties, and is not decomposed in the human system, but eliminated from the body without undergoing any change. It is about 230 times sweeter than the best cane or beetroot sugar. According to Dr. Stutzer, of Bonn, who has carefully investigated the physiological properties of this substance, saccharine, taken into the stomach in the quantities in which it has to be added to food as a sweetening material, has no injurious effect whatever on the human system. Stutzer has given to dogs about 5grms. a-day, without observing any ill effects in them, and when we consider that 5grms. are equal in sweetening power to rather more than 2½lb. of sugar—a quantity far larger than anyone would like to consume in a day—his views seem amply corroborated by this fact alone; but, in addition to this, patients suffering from diabetes have now been treated for several months in one of the principal hospitals in Berlin, as I am informed, without their feeling the least inconvenience by its use. Physicians must be glad to find in saccharine a substance by means of which diabetic persons may enjoy food which has hitherto not been admissible in their case. Saccharine does not belong to the class of carbohydrates, and does not possess nutritive properties. The use of saccharine will, therefore, as indicated by its properties, be not merely as a probable substitute for sugar, but it may even be applied to medicinal purposes where sugar is not permissible. The inventor was fully aware that in order to supply a perfect substitute for cane or beetroot sugar, something else—viz., a similar substance—was needed for confectionery and similar purposes, besides sweetening properties, and he has also endeavoured to solve this problem. Dr. Fahlberg combines glucose with starch sugar, a substance very similar to cane or beetroot sugar, as you know, but inferior to these in sweetening properties, with saccharine, and thus obtains a compound which he calls “dextro-saccharine,” which, as far as the taste is concerned, is scarcely distinguishable from the best sugar. The quantity of “saccharine” used is in the proportion of one part to from 1000 to 2000 parts of glucose. Now, if we look at the price of saccharine, which is, I believe, at present about 50s. a-pound, we shall find that even at this price such a mixture would be very considerably cheaper than real sugar, but we must bear in mind the fact that there is great likelihood of the process of manufacture of saccharine being considerably cheapened; the expensive phosphorus-pentachloride may probably be replaced by a cheaper compound, etc.

It will then be evident, from what you have heard, not only that “saccharine” is a most interesting compound, but that it may also be destined to become an article of primary commercial importance. I must leave to the future to decide as to the revolutions it may bring about in the coal-tar industry, in the cultivation of the soil now devoted to growing canes or beets, and in the sugar industry generally, and other industries connected with it; but as great

and important commercial interests are in question, it is highly advisable to look well into this matter, and not to allow our foreign competitors in this and other markets to secure exclusively for themselves the benefit which this discovery may confer. I have here for your inspection a specimen of pure crystallised “saccharine,” and also small balls made from starch, to which has been added 0.05 per cent. of saccharine, of which one is sufficient to impart a very sweet taste, very similar to that of the best sugar, to a large cup of black coffee. Further, some liquors sweetened with “saccharine,” some lozenges made from “dextro-saccharine,” and also some raspberry syrup sweetened with saccharine; and finally, a small bottle of quinine, the bitter taste of which has been disguised by the addition of a small quantity of “saccharine.” These samples will give you an idea of the various and manifold uses to which saccharine may be put, and which may result in an enormous consumption of the article.

DISCUSSION.

The CHAIRMAN said it might be well to distinguish between the sugar compound *saccharin* and the benzoyl-sulphonic imide by adding the final *e*, and spelling the latter *saccharine*. It was unfortunate that practically the same names were applied to such chemically different substances. “Saccharine” might prove serviceable for sweetening fruit preserves, which might thus practically consist of pure fruit, the amount of saccharine required being very small. Whether the antiseptic power of this compound would prevent the inroads of mould in preserves thus sweetened, remains still a matter for experiment. His friend, Dr. Fahlberg, had been a member of the Society of Chemical Industry from the outset, and his name would be remembered in connection with a remarkable process for the removal of iron from solutions of alumina by means of plumbic dioxide, afterwards more cheaply replaced by “Weldon-mud,” by Spence and Kynaston (this Journal, vol. i. 275).



IVAN LEVINSTEIN IN THE CHAIR.

CHINA GRASS OR RHEA FIBRE.

BY A. SANSONE,

Director of the Manchester Technical School of Dyeing.

HAVING watched very carefully all that has been done in the last few years for the advancement of the study of textile materials, I have come to the conclusion that there is a brilliant future in store for the fibres derived from some of the varieties of the *Urtica* family, and my conviction goes so far on this point as to foresee at no very distant future a new and very important branch of textile industry.

I should like to mention here the valuable book published by Dr. Forbes Royle in 1855 on the “Fibrous Plants of India,” because its study may be useful to those who have invented, or believe they have invented, new methods for the treatment of fibres.

Before describing the processes which have been employed successfully for the extraction of the fibre, it will be necessary to say a few words about the plants themselves, in order to be able to understand the difficulties which had, and have still to a certain extent, to be overcome.

The fibre is found in the bark of the stems, and these reach a height of 3½ to 5½ feet, and under favourable circumstances even more. The size of the

* The solubility of saccharine in ether might probably be useful in detecting its presence when mixed with sugar.

stems varies considerably in thickness, being sometimes half-an-inch, and sometimes even more. When the stems are freshly cut, the bark can be very easily peeled off by hand, and in this case the bark or ribbon contains practically the whole amount of fibre; but if the stems have been standing for some time, or are half dry, or in some cases, as in sunny days, have been cut in the afternoon instead of the morning, then the bark cannot be removed without a certain amount of fibre being lost by adhering to the woody stem which forms the interior.

As well known, China grass of commerce is the product obtained from the stems principally of the *Urtica nivea*, the bark having been first of all stripped off by hand from the stem, and then the raw fibre liberated from the skin and mucilage by scraping with a knife. This product has been used in England for the last forty or fifty years, and since it has been employed for a great variety of purposes, and has been bleached, dyed, and printed without any difficulty; this proves that the separation of the gum from the fibre has been accomplished long ago by well-known methods, employing chemicals of every-day use in the bleach and dyeworks. It is well to bear this in mind when we consider that several processes have been patented in the last few years, in the majority of which it is proposed to employ such simple materials as alkalis and acids, which, so long as there has been any textile industry, have in one form or another always been used.

The methods of treating the stems are twofold, those dealing with the dry and those dealing with the green stems. Several machines have been constructed for treating the dry stems, some of which may be found of utility. There is, however, always a certain amount of loss, and, in many cases, if the woody portion, as often happens in thick stems, is very hard, then the fibre will be cut up or injured; the stems, moreover, must be very dry before they can be effectually treated. But the great difficulty connected with the treatment of the dry stems is to obtain them dry, since in some countries, especially India, the best crops are obtained in the rainy seasons, when it is impossible to dry them. Moreover, the partially dried stems soon begin to ferment, and the fibre is then completely spoilt.

For this reason the Indian Government, in offering prizes for machines for the extraction of the fibre, insists on a construction suitable for dealing with the green stems.

For the above treatment two methods exist, and I am acquainted with both of them; one involves the employment of the Smith's or Death & Ellwood machine, the other two distinct operations the Favier-Frémy methods.

I have been making for the last six or seven months experiments on green stems, which have been kindly supplied on two occasions to me by Professor Thisleton Dyer, the Director of the Kew Botanical Gardens, and of dry stems grown on the Continent, of which I have had ample supply for experimental purposes. I have come to the conclusion that the methods of treatment must be modified according to local circumstances with respect to climate, water, labour, means of transport, etc., and that one method which will be found to answer under one set of conditions will not necessarily hold good under other conditions.

In my opinion, if the fibre of these nettles is to be employed at all, it must be produced so as to be as cheap, and, in fact, cheaper than cotton, and consequently the methods of treatment must be as inexpensive as possible. The simplest method of treatment, following the long experience of the Chinese and other Eastern nations, would be simply

to peel off the bark from the green stems by hand as soon as they are cut, and then dry the bark. This latter could then be shipped to this country for treatment by a chemical process for the extraction of the fibre,—this is, in fact, already done; the only change that could be introduced being the employment of a machine for the stripping off or decortication of the stems—without, however, attempting to extract the fibre at the same time. Machines could be easily devised for this purpose. The difficulty in the treatment of stems freshly cut is that they must be stripped off immediately, and this done by hand would require for large plantations an enormous number of women or children. The difficulty of obtaining sufficient manual labour would be to a certain extent got over by the employment of machines, but a large number of these machines would also be required, and this of course means considerable outlay. I have been therefore considering if something could be devised which would allow of the treatment of the stems at any time of the year and not only at the period of the crops. The simple method I propose I have been led to by considering the results of many experiments, both on green and dry stems. The method is a very simple one, and does not require any expensive plant or apparatus. The method is the following:—

The stems, either green, half dry, or even dry, are boiled in a solution containing carbonated or caustic alkalis. If the stems are green, five to ten minutes' treatment is sufficient, and the bark can then be peeled off without difficulty and without leaving any fibre attached to the wood.

If the stems are half dry they require longer boiling (say 15 minutes), whilst completely dry they require from 20 to 25 minutes. In all cases the bark can be readily peeled off, and could be dried, or washed and dried, and then packed in bales for export. It must be observed that the boiling can be done in an ordinary open boiler of small size, and that if the stems are dry they can even be treated under pressure. It may be asked, What advantage is there in thus boiling the stems? The advantages are as follows:—Firstly, the stems can be treated all the year round in localities where it is not difficult to dry them. They can be kept in store by simple and inexpensive means, and treated when most convenient, since one ordinary open boiler heated over a free fire can be used for treating large quantities. The stems are to be quite immersed during the boiling. They are afterwards removed for stripping, and other stems are then immersed in the same water, which could be kept meanwhile boiling, and only being changed occasionally, and replenished from time to time with more alkaline lye. The woody portion of the stems furnishing very good fuel, it could be employed for heating the boiler, and the ashes would furnish the requisite alkali, since it has been found by analysis that these ashes are very rich in potash and soda. This system of treatment would be especially valuable for small farmers, who would then employ the time they do not spend in the fields for the decortication of these stems. Secondly, when stripping off bark from the green stems, since they are very liable to ferment (even if dry) during a long sea voyage, when exposed to moisture, a boiling in soda is sometimes found necessary before exportation. The work thus done is by no means lost, for by this boiling a certain amount of gum can be removed, along with part of the skin and other impurities, if after boiling and stripping the ribbons be washed with cold water before drying. The boiling of the stems with alkalis is not a new idea, for it is mentioned in Dr. Royle's work, p. 346 (Wright & Co.'s Patent, 1849). However, I think the idea in the form I give it is new. Some of the

specimens I exhibit to-night have been produced in the laboratory of the School of Dyeing; dry stems of several months' standing have been boiled with caustic soda under pressure in a mason's kier. I have frequently treated varying quantities of these stems (once over 2 kilos.), and in all cases after sufficient boiling the bark could be peeled off with the greatest ease, even when thoroughly cold, and the very day after they had been boiled. There would be no difficulty, even in this case, in peeling by machinery. Another advantage in this treatment will appear shortly. In countries like India, where the stems cannot be dried, the method referred to may not have the same importance as in countries where it cannot be carried out, and I have tried to devise means by which this difficulty could be overcome. It is well known that the stems of these nettles are very liable to mould, but it is equally well known that this evil can be prevented by the use of suitable antiseptics, such as sulphurous acid, sulphites, or bisulphites.

The method I would propose for employment in India and in other countries in the rainy season, would be simply to place the stems in large pits or cisterns, with a solution of sulphurous acid or bisulphites, and keep them there until they can be worked by whatever process.

Green stems left in bisulphite of soda solution last summer for several weeks were found quite fresh, and were then treated without difficulty. I do not consider that the heat in India would prevent the sulphurous acid or bisulphite solution from preventing the fermentation, or rather the putrefaction, of these stems, by constructing underground pits or cisterns and covering them with light wooden sheds. The employment of sulphurous acid and bisulphites for this purpose is, I believe, a novel one, and so I think I may claim the credit of suggesting it. It has, moreover, the additional advantage that it bleaches the fibre to a certain extent, for I have been able to obtain a white fibre much more readily than from stems or bark treated differently. I have, in fact, devised and successfully carried out a method for the ungumming and bleaching of the fibre from the stems of the nettles by the aid of sulphurous acid or bisulphites, in conjunction with alkaline treatment. In doing this I do not so much desire to claim any credit for the discovery, as to prevent others from patenting a process which I would more willingly contribute for the public benefit.

In many of the methods employed for the extraction of the fibre either from the barks, or even from the raw fibre, generally boiling solutions of alkalis (either carbonate or caustic soda) are used, and the alkaline treatment is followed by one of souring with hydrochloric acid. Others employ bisulphite or sulphurous acid solutions, under pressure. The method which I propose is the following:—The raw fibre, from whichever process, is treated with boiling alkaline solutions (a method employed for the purpose from time immemorial by the Chinese). It is then generally washed, and the material is immersed for a few hours, or even a day or two, in cold weak solutions of bisulphite of soda or lime, or even in sulphurous acid. The fibre is then washed, boiled again with alkalis, and this is repeated with the bisulphite bath if necessary. The bleaching can then be effected by means of solutions of sodium, potassium, or magnesium hypochlorites, but the bleaching powder (chloride of lime) must in all cases be avoided.

In general the bleaching of China grass or rhea fibre is very similar to that of linen, and the same precaution must be taken in the employment of the hypochlorites; but provided that the impurities have

been carefully removed beforehand by the proper scouring process, the bleaching itself does not offer any difficulty whatever, and can even be effected much more readily. The fibre in fact stands, as regards stability, between linen and cotton towards bleaching solutions.

For the scouring either of the raw fibre, or even of the bark of the stems, the usual scouring agents may be employed. Besides carbonate or caustic soda, caustic lime can be very well used for the first boiling. Working in kiers under pressure in the ordinary way will also be found to expedite matters, as might be expected. Rosin soap can also be very effectually used, and so can the mineral acids so largely employed for cotton bleaching.

In dyeing no great difficulty is experienced in the fixation of colouring matters on the fibre. This cannot be so readily dyed as cotton, but in this respect it resembles more closely linen. Turkey reds cannot be very well produced by the new process with oleine, while very good colours are obtainable with the older method of oiling with olive oils. Aniline colours require, as on cotton, mordants for their fixation, and give very good and bright effects; but metallic colours, such as chrome yellow, spoil the look of the fibre by depriving it of lustre. It must also be observed that in dyeing the fibre before spinning the lustre is not lost, whilst this is very often the case if it be dyed in the yarn.

Printing so far has only been tried to a small extent on fabrics produced with this fibre, but I do not apprehend any difficulty in this direction.

Special care will have to be taken in the finishing, especially of heavy goods. It must be remembered that the fibre is not so elastic as cotton, and consequently it must not be exposed to such heavy pressure.

It will be necessary to observe that the dry stems will yield about 10 to 15 per cent. of pure bleached fibre ready for spinning, and it may be asked what is done with the other portion of the stem or the woody part.

So far the wood has not been utilised except as fuel or as manure along with the branches and the leaves of the plant. The leaves have also been used as food for cattle. It had occurred to me that since for every ton of fibre which is produced there are generally four to six tons of wooden sticks, to ascertain if these could be utilised for some industrial purpose. I find that these sticks could be very well employed in paper making, at all events for the manufacture of special kind of wood pulp.

As can be seen from some of the specimens exhibited, a peculiar kind of paper can be obtained which is in some cases very stiff and requires no size in its production. Very likely this is due to the natural gum which is contained in the plant, and which, as well known, imparts to the raw fibre considerable stiffness.

In my experiments on this woody portion, I have been struck by the similarity of the structure of the bark containing the fibre to that of the stick. These constituents behave to chemical reagents alike, excepting that the wood requires a more severe treatment for its disintegration, and especially for its bleaching.

Bearing in mind the possibility of the utilisation of this wood for the manufacture of wood pulp and for other purposes, it will be seen that the methods I proposed for the decortication, or for the separation of the bark, will be found to possess the advantage that

the wood will have already undergone a certain amount of treatment which, by depriving it of some of its soluble constituents, effects a reduction in weight and cheaper transport.

From a commercial point of view, if we have two marketable articles produced, both the fibre and the wood pulp instead of only the fibre, then the question of the cultivation of the plants is raised to a still higher platform of probable financial success.

DISCUSSION.

Mr. THOMSON asked the author why he advocated a preliminary treatment of the fibre with caustic soda, seeing that it must materially increase the expense? If it were true that the fibre in its green state could be easily stripped off the stem, surely that would be the best mode of treatment. Also if the sun were not sufficient to thoroughly dry the bark, might it not be dried in an oven, for heating which the refuse pith or decorticated stem would serve as fuel? It would bear transit without fear of fermentation. After many experiments he had come to the conclusion that bisulphite of lime was a much better antiseptic than bisulphite of soda. As regarded the percentage of fibre in the green stem as given by the author, he thought it high, his impression being that it was about 3 per cent. or one ton of fibre for every 33 tons of green stems.

Mr. SANSONE, in reply to Mr. Thomson, said that when the bark of the stem is peeled off by hand, and dried, on long sea voyages, when exposed to moisture, it readily begins to ferment. Thus sometimes fibre is spoiled. For this reason it has been suggested that the stems should be boiled in carbonate of soda. If treated in this manner they might just as well boil the stems, the wood portion of which possibly could be used for paper making, and in this case there would be something gained. I do not apprehend any difficulty with regard to the application of bisulphite of lime on the spot, as the process is not so complicated, but such as the natives of India would be able to use. Again, it might be carried out under the superintendence of competent men sent out for the purpose. There is another point which deserves attention at the hands of the chemist, and that is in reference to a kind of coagulation which takes place in the stem on steaming or boiling. What the product is which is coagulated, I am not able to say, but it forms a problem well worthy of solution. Dr. Forbes Watson mentions, in a report, on Rhea published some years ago, that in some experiments made in India on the green stems with the Greig machine, the cylinders were coated with a kind of gum so hard that it had to be broken off with a chisel. The industry was introduced into England about 1840, and this material has been worked for years in Bradford and Manchester, and is being used pretty extensively at the present time. One reason why it has not been extended more is owing to the irregularity of supply from China, where the process of scraping the bark from the stem with a knife is a very slow method, and up to within a few months ago it was not possible to treat the fibre on a commercial scale. Recently, however, the raw material has been produced on a larger scale, and proper methods are in vogue for working it. Again, we must not confuse China grass with Rhea fibre. Rhea grass is what they are trying to cultivate on a large scale in India and other countries where the soil is more suitable, and I should not be surprised to see shortly sufficient quantities coming into our markets, to make it worth the while of anyone to work up.

Newcastle Section.

Chairman: J. C. Stevenson, M.P.

Vice-Chairman: B. S. Proctor.

Auditor: N. H. Martin.

Committee:

Alfred Allhusen.
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C. H. Gimingham.
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John Morrison.

F. S. Newall.
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H. R. Proctor.
W. W. Proctor.
J. F. Stark.
T. W. Stuart.

Local Secretary and Treasurer: J. T. Dunn, 115, Scotswood Road, Newcastle.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

RECENT CONTRIBUTIONS TO THE ESTIMATION OF TANNINS.

BY H. R. PROCTOR, F.C.S.

IN more than one paper read before this Society or its predecessor, the Newcastle Chemical Society, I have expressed the opinion that Löwenthal's process for the estimation of tannin based upon its oxidation with permanganate in presence of indigo, was to be preferred for general use to any other yet proposed. This is probably still the case, but longer experience has demonstrated that there are certain inherent defects in the method, which preclude its ever being of the highest scientific accuracy, and which require strict attention to ensure even the degree of exactness which is needed for technical purposes.

The first of these points is that the quantity of permanganate consumed is largely dependent on the rate at which it is added. To account for this, it does not seem necessary to adopt any complicated hypothesis as to the "speed of chemical action." The simple fact is, that the oxidation is not a complete one, like that of oxalic acid, in which the end-products are simply carbonic acid and water. When the whole of the indigo is decolourised, it may be taken for granted, under the conditions of the process, that all the astringent and other matters more readily oxidisable than indigo are also destroyed, but there remain in the solution products of this decomposition which, though less easily oxidised, will still readily reduce permanganate when indigo is absent. If, therefore, in the course of the titration, permanganate be rapidly added, it will destroy the indigo with which it comes in contact, and then proceed to further oxidise these products of decomposition, thus leading to too high a result. It is also obvious, that even in the most carefully conducted titration, more or less of this action will take place, and in extreme cases the variation so introduced may amount to more than 30 per cent. of the total.

To investigate this and other causes of discrepancy, and, if possible, to agree on some standard method by which they should be excluded, in 1883 the Association of German Tanners invited the principal German experts to hold a conference on the subject in Berlin. The result of their deliberations has appeared in the past year in the form of a report,* consisting mainly of a valuable study of the process, by Prof. Von Schroeder, and a description of his modifications, which the Commission recommend for general adoption.

The most important part of the report is that dealing with the error of which I have already spoken.

* Bericht über die Verhandlung der Commission zur Feststellung einer einheitlichen Methode der Gerbstoffbestimmung, Cassel, 1885.

While it is evident that it is impossible to establish a definite value for tannin, as compared to oxalic acid, it is obvious that if the permanganate be standardised against a solution of pure tannin, under rigidly the same conditions as those of the actual analysis, the error introduced will be the same in both cases, and will consequently be cancelled. The practical difficulty in this is that absolutely pure tannin is unattainable, the purest article to be met with in commerce being largely contaminated with gallic acid and other impurities. Prof. Von Schroeder has met this difficulty in a most ingenious way. As gallic acid consumes slightly more permanganate than an equal weight of tannin, such an impure tannin gives a result differing but little from that of a pure sample, but reduces slightly more permanganate; so that, taking the average of six of the purest German sorts, 1000 of dry commercial tannin reduced the same quantity of permanganate as 1048 of the tannin precipitated by hide, as determined by careful analysis by Hammer's method. Prof. Von Schroeder, therefore, determines simply the permanganate consumed by 10cc. of a solution containing 2grms. per litre of air-dry commercial "pure" tannin, calculates the dry matter, and multiplies it by the round number 1.05 to obtain the value in actual tannin precipitable by hide. It is not found necessary to determine the moisture in the tannin used for each analysis, as air-dried tannin in a well-corked bottle remains long unaltered. To determine whether a given tannin is pure enough to be used in this way, 2grms. of the air-dried tannin is dissolved in a litre of water, 10cc. of the solution are titrated, and 50cc. are digested 18—20 hours with 3grms. of moistened hide powder, with frequent shaking; 10cc. of the filtrate is then titrated, and if the permanganate it consumes amounts to less than 10 per cent. of the total consumed by the tannin, it may be taken as being one of the best of commercial preparations, and suitable for the purpose in view.

Ingenious and practically accurate as this method undoubtedly is, there is something scarcely satisfactory in using an impure substance to standardise with; and as gallotannic acid is, after all, not identical with most of the tannins we have to determine, there seems no special necessity for its use, if a body of more definite composition can be found which is similarly oxidised in presence of indigo. Such a body, I think, we have in gallic acid, which, from its ready solubility in boiling water, is easily purified by crystallisation. It gives a very sharp end-reaction in presence of indigo, and is quite as closely allied to many of the natural tannins as gallotannic acid itself. More experiments are needed to determine whether the relative values of tannin to gallic acid and permanganate are constant ones under all conditions, but the mean of a considerable number of titrations give 1.35grm. of pure tannin (as calculated by Prof. Von Schroeder's method) as equal in reducing power to 1.00grm. of ordinary crystallised gallic acid.

The tannin used was Schering's Ph. Ger., which was found by Prof. Von. Schroeder the best of all he examined; but my sample, obtained through Dr. Roth, of Berlin, does not seem so pure as his, leaving after prolonged treatment with hide-powder a residue unabsorbed equal to 11.1 per cent. of the total permanganate used.

As an additional safeguard, besides standardisation with tannin, Prof. Von Schroeder proposes the general adoption of a mode of titration which he calls the "one cubic centimeter method," and which consists in the addition of the permanganate solution, 1cc. at a time, with vigorous stirring after each addition, till the colour of the liquid indicates that a few drops only are required to end the titration, when it is added drop by drop till the reaction is complete.

Though this method, when uniformly carried out, gives constant results, and will, therefore, like any other fulfilling this condition, give accurate values when employed both for standardising and analysis, it seems to me, even as compared with the usual drop method, to be a step in the wrong direction both theoretically and practically. Instead of endeavouring as far as possible to prevent the secondary oxidation, it attempts to fix it at a definite but rather considerable amount. Taking Prof. Von Schroeder's own numbers, the increased secondary action, as compared with the drop method, amounts to 18 per cent. of the total permanganate, and, according to all scientific analogy, this considerable quantity must be subject to far larger fluctuations from accidental circumstances than one tending very closely to an irreducible minimum.

Further, if we accept the explanation which I have offered of the causes of this secondary action, it will be obvious that it is not dependent directly on the mere time of titration, but rather on the rapidity of mixture; and that hence the 1cc. method would be influenced far more than the drop method by the vigour of the stirring. This proved to be the case. In order to test it, I constructed a special stirrer, consisting of a perforated earthenware disc, approximately fitting the beaker, and worked up and down in it like a piston by a glass rod. To avoid repetition, I give the results of one series only of titrations, which were performed alternately with the disc stirrer and an ordinary glass rod.

20cc. Indigo alone—

	Drop Method.	1cc. Method.
With disc stirrer	{ 5.6 5.7 5.6 5.6	(disc worked continuously)
With glass rod in beaker.....	{ 5.65 5.75 5.6 5.75	(stirrer at rest while actually adding permanganate.)

20cc. Indigo 5cc. Infusion—

With disc stirrer	{ 14.3 14.3 14.4 14.5	(as before).
With glass rod in beaker	{ 14.6 15.5 11.7 15.7	(as before).

For comparison, I also give the result obtained by drop method, in basin with rod—viz., 14.8, 14.7, from which it appears that mixture in a basin is slower than in a beaker with a rod stirrer.

From these numbers it will be seen that both indigo alone, and more especially mixtures of indigo and tannin, give very different results according to the vigour of the stirring, and that these variations are, as might be expected, much greater with the "1cc." than with the "drop" method, and also with the simple rod than with the much more efficient disc stirrer. As such irregularities of stirring are more or less unavoidable in all titrations, there seems strong reason for preferring the "drop" to the "1cc." method; but whichever be adopted as a standard, it is imperative that the method of stirring be strictly defined.

Although I adopted the disc stirrer at first as an experiment, I have found it answer its purpose so effectually that I now employ it in all my analyses, and find it greatly conduces to constancy of result, and the white earthenware disc makes the change of colour of the liquid very visible.

I have found, however, that even with the disc stirrer it is possible, by varying the rate of addition of permanganate, to materially alter the results; and I have adopted a plan which seems to overcome this difficulty very satisfactorily for practical purposes. Instead of attempting to regulate the speed of flow by the tap of the burette, I draw out a small piece of quill tubing to a capillary point, and attach it to the bottom of the burette with indiarubber tube. If

the small tube fits like a cap on that of the burette, it comes very little in contact with the permanganate, and is very slowly affected by the weak solution (1grm. per litre) which I employ. When I have finished an analysis I always remove it, and place it in a little of the dilute acid solution of a finished titration, not only to save the rubber, but to dissolve any oxide of manganese which might be deposited in the point, and so affect its flow. The solution in use flows at first in a capillary stream, and as the pressure is reduced it begins to drop; but if approximately the same quantity is used, and the burette is fresh filled for each test, the rate of delivery is very uniform, and it seems not to affect results even if it be so slowed as to drop throughout the titration. My tube delivers the first 10cc. in about 100sec. Of course, it is necessary to employ a perfectly clear solution of permanganate, and it is desirable so to arrange the strengths or quantities of tannin infusion that about the same proportion of permanganate may be used in the actual analysis as in the standardising.

As it is possible, using a 25cc. burette, to read to $\frac{1}{20}$ th cc., which is a decidedly smaller quantity than the unavoidable errors from uncertainty of end-reaction and other causes, there seems no use in employing so large a quantity as 20cc. indigo solution in $\frac{1}{2}$ litre water, and a considerable saving of time is effected by halving the quantities without, I think, any less exactness. I find, also, that I can obtain greater accuracy by titrating to a primrose yellow than by going further, as in the first case an additional drop makes a distinct difference, while when the indigo is all destroyed additional permanganate makes no permanent change. As it is not possible to retain a definite tint clearly in the memory, I take a beaker full of the yellow liquid of a complete titration, to which slight excess of permanganate has been added, and, after allowing it to stand a little, I add one drop of indigo, and place it beside the beaker in use for comparison.

The second point of difficulty to which I alluded at the beginning of my paper, is the removal of the tannin. It will be remembered that permanganate oxidises all astringents and many other bodies in presence of indigo, and that it is therefore necessary to remove the tannin from a portion of the liquid and make a second titration, so as to obtain the tannin by difference. One of the earliest, and possibly one of the best, ways of doing this—though, as I shall show, it has one very serious defect—is by the use of finely-powdered hide. This method has been very carefully studied by Prof. Von Schroeder, and the Commission seem to have determined, almost without discussion, that it was to be employed in preference to gelatin or any other solution to effect the separation. Von Schroeder directs that 3grms. of hide powder should be softened for about 20 hours in distilled water, collected on a washed linen filter, washed repeatedly with distilled water, and squeezed in the linen first with the fingers and then in a clean pocket-handkerchief. The moist hide is now easily made into a ball with the fingers, and introduced into a flask of about 150cc. capacity; 50cc. of extract, which must not contain more than 0.1grm. of tannin, is added, the flask well corked, and the whole allowed to digest, with frequent shaking, for 18 or 20 hours. The liquid is then filtered, and 10cc. titrated like the original extract, when the loss gives the permanganate equivalent of the tannin absorbed. Von Schroeder shows by experiment and calculation that the water introduced with the hide may be disregarded without introducing sensible error.

If hide powder is to be used, it is of the utmost importance that it should be properly prepared and purified. Detailed directions for this are given in

the report, but as the process is somewhat troublesome, especially for small quantities, most chemists will be glad to learn that it may be obtained, of excellent quality, both of Dr. Roth, of Berlin, who has undertaken to prepare it according to Prof. Von Schroeder's directions, and from the *Versuchstation für Lederindustrie* in Vienna, and Messrs. Mawson & Swan of Newcastle, have kindly undertaken to keep it in stock, together with the other articles required in tannin analysis. This hide powder is very white and light, and gives up nothing to water capable of affecting permanganate in the Löwenthal test, and, indeed, so little matter of any sort, that the Vienna *Versuchstation* is now employing a method of analysis dependent on evaporating of a given quantity of the infusion before and after absorption, and weighing the residues of absorption.

It is a distinct disadvantage of this method for technical purposes, that so much time is required for its execution as often to make its use impracticable in the limited time allowed for decision on the relative merits of different samples. A more serious defect, however, is that hide powder absorbs gallic acid freely. I showed, in a paper on "Müntz and Ramsbacher's Apparatus for the Estimation of Tannin," read before the Newcastle Chemical Society in March, 1876, that raw hide is capable of withdrawing most acids from their solutions, to form the sort of molecular combination which leads to the swelling of the hide. In an experiment there quoted, as much as 41 per cent. of gallic acid was removed from a dilute solution. It was therefore a matter of no great surprise to me that a solution of gallic acid containing 2grms. per litre, when treated with hide powder, as directed by Von Schroeder, lost 55 per cent. of the total gallic acid it contained. This fact seems to put hide powder completely out of court in estimating tannin materials containing gallic acid.

Mr. Bertram Hunt, in a valuable paper, vol. iv. p. 263 of the Journal of this Society, points out that gelatin solution, followed by saturation with salt and addition of acid, as proposed by me, also precipitates a portion of gallic acid amounting to about 17 per cent. I can quite confirm this result, and the error, though less than that caused by hide powder, is a sufficiently serious one. Mr. Hunt proposes to remedy it by using only 25 per cent. of a saturated solution of salt, instead of saturating the whole mixture, and he shows that by this means the precipitation of gallic acid is almost *nil*. This method is very similar to Löwenthal's original one, and identical with my earlier practice. I only adopted the saturation method after it had been proved by Simand* that gelatin tannates were soluble to a small extent, varying with the nature of the tannin, in this unsaturated salt solution, and that consequently larger or smaller results were obtained according to the concentration of the tannin infusion employed. It was to obviate this, and not for the sake of getting a clear filtrate—which, in fact, is more easily obtained without saturation—that I adopted the saturating plan, and it was its adoption which rendered the use of kaolin a necessity. If, therefore, we return to the use of unsaturated solutions, we have to face imperfect precipitation of the tannin, while if we saturate we precipitate a portion of the gallic acid, if any be present; and, of course, by choosing a proper concentration in any given case the two errors will compensate each other, and yield an apparently accurate result. This is a very unfortunate state of affairs, and a more satisfactory mode of separating tannin is a great *desideratum*. The error is not, however, of so great practical importance as it looks,

* Dingl. Polyt. Journal, Bd. 224, S. 400.

since the total of gallic acid is in most tanning materials only a small one.

In the discussion which followed Mr. Hunt's paper, it was pointed out by several chemists that the gelatin method did not give satisfactory results as to the value of tannins for dyeing purposes. This is only to be expected. There is a great variety of tannins and "tannin colouring matters," all of which are taken up by hide and precipitated by salted gelatin, but by no means all give good blacks with iron, or will precipitate tartar emetic. With such varied and little understood bodies as the tannins, the mode of analysis must be chosen in relation to the use to which the materials are to be put. If the object is to precipitate antimony, naturally Gerland's tartar emetic method is more likely to give good results than a gelatin process. If ink-making or dyeing black is the requirement, Handke's process with ferric acetate, or a colorimetric method, would suggest itself. If fixing aniline colours is required, an aniline colour, such as methyl-green, may be used as a precipitant. In all these methods we are not really determining the quantity of a given ingredient present, but the activity in a special direction of a mixture of various compounds. It is therefore most essential that the chemist should specify not only his results, but also how his results are obtained.

In the case of most tannin materials the sampling, grinding, and extraction are as important, and as likely, if unsystematically carried out, to lead to discrepancies, as any other part of the process. As the German Commission make no fresh suggestion on the two former points, and I have already discussed it pretty thoroughly in my recent book on tanning,* I need not here enter further into the matter. For extraction, Von Schroeder has invented a very neat little apparatus, which has been adopted by the Commission, and of which I have an example on the table. It consists of a perfectly cylindrical vessel of cast tin, about 12.5cm. high and 7cm. in diameter, and furnished with a spout. Into this fits a perforated strainer or piston, which in use is covered with muslin, and which must move freely up and down, but fit sufficiently closely to compel all the liquid on depressing the piston to flow through the strainer. 5, 10, or 20grms. of the material, according to its strength, is weighed into the extractor, covered with 200cc. of distilled water, and allowed to remain, with occasional stirring, for 12 hours. The piston is then pressed in, and the clear extract poured into a little flask, and replaced by 200cc. of boiling water. On drawing up the piston the water passes through and rinses it, and it may then be laid on a plate, or set slanting in the mouth of the extractor till again required. The extractor is then heated in the water-bath for half an hour, with occasional stirring; the liquor is pressed out and poured into the litre flask, and the process repeated five times in all. Evaporation will still allow of the extractor being rinsed out with small portions of water, and, after cooling, the flask is filled up to the mark, and if necessary filtered. Where liquids are obstinately turbid, the addition of a little kaolin, as suggested by the writer, and approved of by Von Schroeder, will enable a clear filtrate to be obtained.

Directions for the separation of "easily" and "difficultly soluble" tannins by cold extraction with the Real's press or percolator are given, but as no attention to this point has been paid in England, and it seems one of very doubtful importance, the reader is referred to the original paper for details.

In my own work it is frequently essential that results should be known within 24 hours of the time of

receiving the sample, and I am, therefore, unable to adopt Professor Von Schroeder's method of extraction. I find, however, that brisk boiling for half an hour in a large flask with a litre of water, cooling, rinsing into a litre flask and making up to the mark, as described by me in a previous paper, is not only a very rapid but a very thorough and uniform mode of extraction. I hope when time permits to make a careful comparison of the two methods, but in the few experiments I have yet made, simple boiling has given fully as complete an extraction as the Von Schroeder extractor. I may remark that it is quite unnecessary to filter the liquid before making up to volume, as the bulk of the material employed introduces no sensible error, while filtration and washing consume a great deal of time. Of course, after making up to bulk and thoroughly shaking, the quantity required for actual use must be passed through paper.



ON AN ALLEGED ERROR IN USING THE NITROMETER.

BY G. LUNGE.

IN No. 1362 of the *Chemical News* (vol. 53, p. 6), Mr. Thomas Bayley again asserts that erroneous results are obtained in using the nitrometer, owing to the solubility of nitric oxide in the acid liquid, unless the liquid contained in the apparatus at the end of the operation is diluted with water. My experiments, intended to prove the contrary—viz., that no such dilution is required in order to obtain accurate results—are represented as being beside the mark, since I had "overlooked the all-important fact that the liquid floating upon the mercury contained in a nitrometer is not pure sulphuric acid, but a solution of mercurous nitrate in sulphuric acid." "Now the ordinary text-books and works of reference (*e.g.*, 'Watts' Dictionary,' 'Gmelin's Handbook,' etc.) credit the subsalts of mercury and other metals with the power of dissolving nitric oxide gas." Over and above these remarks, Mr. Bayley quotes the results of experiments made by a gentleman whose name is not mentioned (and whose authority, therefore, must be held in abeyance), and some of his own. In the latter he obtained an additional 0.5 or 0.45cc. of NO by diluting the liquid at the end of the experiment; in the second set of experiments he allowed the gas to escape, so that only liquid remained in the tube, and on adding water to the liquid he invariably obtained a further liberation of NO. Lastly, he made the experiment of passing dried NO through a solution of mercurous sulphate in strong sulphuric acid, when 14.678grms. of acid gained 0.0098grms. of NO (?).

I am sorry I must still disagree from Mr. Bayley; I must re-assert that no such error exists as is maintained by him, and that his own results cannot be accounted for otherwise than by experimental errors, such as I have seen to occur times out of number to my students before they had thoroughly mastered the handling of the nitrometer, and as have sometimes occurred to myself, although I could not possibly overlook them, and hence always condemned such tests as useless.

Let us see what evidence Mr. Bayley adduces in his favour. First of all come "the ordinary text-books and works of reference," which are said to mention the solubility of NO in the subsalts of mercury and other metals. Now even if they did, that would not be decisive, for it is quite clear that an aqueous solution of such subsalts (and another would not be meant) might and probably would behave

* "A Text book of Tanning," by H. R. Procter. Spon, 1885.

quite differently from strong sulphuric acid containing a little mercurous sulphate in solution. But do "the ordinary text-books and works of reference" state what Mr. Bayley asserts? I have looked through all the very numerous text-books and works of reference in my library, English, French, and German, but not in *one* case have I found a word about mercurous salts being solvents for NO. It is true "Watts' Dictionary" and the English edition of Gmelin are not in my possession, nor could they be obtained here. I have therefore drawn upon the kindness of my friend Mr. John Pattinson, who has found the places in Watts and Gmelin mentioned by Mr. Bayley, but who has equally found no further mention of the alleged fact in any other of the handbooks consulted by him. He has sent me a verbatim copy of the quotations in question, from which it appears that they are not very convincing. In "Watts' Dictionary" it is said: "Nitric oxide is likewise absorbed by stannous and mercurous salts, and forms crystalline compounds with stannic chloride and with sulphuric acid or anhydride." The last half of the sentence seems to show that it does not refer to the solubility of NO in aqueous or other solutions of salts, but to its combination with certain bodies, in which distinct compounds are formed, not by simple addition, but connected with chemical changes (as when NO combines with SO_2 , when SO_2 is given off).

In "Gmelin's Handbook" the solubility of NO in mercurial salts is only mentioned when describing the preparation of NO in the *liquid* form, under a pressure of from 20 to 50 atmospheres, by means of copper and nitric acid within a sealed bent tube: "Mercury cannot be used instead of copper in this case, because the mercurial solution absorbs the nitric oxide gas, so that the pressure never rises above two atmospheres." That this observation (which is not mentioned in the latest German edition of Gmelin, by Kraut) has very little to do with the reactions in the nitrometer is quite evident.

Since these quotations certainly do not decide the question at issue, we shall have to have recourse to the ultimate and assuredly the only criterion—that is, the experiment, all the more as it is a very different thing whether NO is soluble in a liquid, and whether it is driven out by dilution with water. Mr. Bayley thinks that the heat generated in that case would drive out the nitric oxide; but then it would be absorbed again during the cooling down of the apparatus. In any case we need not trouble ourselves on that head, if we can prove that *no gas is given off at all by diluting the liquid*, and this is most certainly the case *when the operation in the nitrometer has been properly conducted*.

I have made quite a number of experiments by treating ordinary nitrous vitriol in the nitrometer, at the end of which, after proper cooling and levelling and reading off, I added water amounting to from half to the whole of the bulk of the acid liquid; after shaking, cooling, and properly levelling again (as tested by the immovability of a column of water in the narrow part above the tap, when very cautiously opening the latter), *the volume of gas was always found absolutely the same as before*. In point of fact no bubbles of gas were given off when the water and acid got mixed.

I have also repeatedly tried the second kind of experiment made by Mr. Bayley—viz., shaking nitrous vitriol in the nitrometer till the reaction was complete, allowing the gas to escape, so that only the acid liquid remained above the mercury, and adding water equal in volume to the acid liquid. But apart from the first case, which instantly opened my eyes to the possible source of error, *I never obtained any liberation of gas whatever by this method*.

Lest my results should appear biased by my previous utterances in this matter, I requested my friend, Professor Treadwell, of the Analytical Laboratory of the Polytechnicum, to repeat my experiments, and he empowers me to state that he also found no evolution of gas on diluting the acid liquid with water. Lastly, in order to convince myself whether any special manipulative skill, such as a professor may be credited with, was required to avoid the error into which Mr. Bayley and his anonymous friend have fallen, I had the experiments repeated by one of my students, Mr. Karl Schniter, who had never had a nitrometer in his hands until the day before. Of course I explained to him how to avoid mistakes, and he also confirmed our previous results in every way. After this I did not think it worth while repeating Mr. Bayley's experiments in which he found that 14.678 grms. of sulphuric acid, holding some mercurous sulphate in solution, and being contained in a Geissler bulb-apparatus, gained 0.0098 grm. in weight when dry (?) NO was passed through it from time to time. That slight increase in weight of a glass apparatus filled with strong sulphuric acid does not seem to carry much conviction.

I shall not venture to hazard a guess by what fault of manipulation the erroneous results obtained by Mr. Bayley and his friend may have been caused, but I think it only right to point out to the very numerous class of chemists who employ the nitrometer, and more especially to the less experienced among them, what is the most probable source of error with that apparatus. Leaving out of consideration such things as insufficient cooling, wrong levelling, leaky taps, and the like, I would draw special attention to one point which has caused me to reject very many of my own tests, and which I have often found to be insufficiently appreciated by my students. When shaking the acid and mercury, it generally occurs that a drop of acid pertinaciously clings to the narrow part of the tube immediately below the tap. Unless this drop of acid is caused to flow down by jerking, shaking up, and several times repeating this operation, so that the mercurial froth gets quite up to the tap, a portion of the nitrous acid will escape decomposition. This is easily noticed when successively forcing out the gas, the acid liquid, and at last a little mercury through the tap. As soon as the mercury reaches that narrow part, where an undecomposed drop or film of acid had lodged, there will be a slight effervescence, and this furnishes proof that the test has been low. If, however, after the ordinary shaking, settling, and reading off, some water were run into the tube, it would wash down that undecomposed acid and, on shaking with mercury, some more nitric oxide would be given off. That may be 0.5, as Mr. Bayley has frequently found, or more or less, according to the original fault in manipulation.

Again, when allowing the gas to escape and then adding water to the acid, you may easily obtain an additional 0.5 of gas, or even far more than that, by either of the following mistakes. If, on letting out the gas, the pressure for a moment became too low (as happens very easily), some air would enter into the tube and get mixed with the nitric oxide; this would instantly form higher oxides of nitrogen, which would be just as instantly absorbed by the acid within the tube, and, of course, give off more NO after diluting and shaking up with mercury. But even if this had been avoided, the nitric oxide would unite with oxygen in the cup surmounting the tap, and the products would be partially retained by the acid film covering the inside of the cup. If it was neglected to rinse the cup *most thoroughly* before adding the water in Mr. Bayley's second experiment, the water would be charged with a little nitrous acid, and would, of

course, give off nitric acid within the nitrometer. When the precautions just mentioned are thoroughly observed, and, of course, the apparatus is otherwise properly manipulated, there is no sensible quantity of NO either retained in the acid at first (as proved by hundreds of tests with pure materials) or liberated by a subsequent addition of water.

As I do not wish to protract this controversy any longer, I expressly declare that I neither affirm nor deny the fact that the nitrometer acid may keep minute quantities of nitric oxide in solution; but I affirm that these quantities must be, in any case, so minute as to be inappreciable in practical work, and I deny that the addition of water causes the operation to be more correct by the liberation of a sensible quantity of nitric oxide, previously dissolved in the acid liquid.

DISCUSSION.

MR. JOHN PATTINSON: My assistant, Mr. Laidler, and I have very carefully repeated Mr. Bayley's experiments as described by him in the *Chemical News* of January 1, 1886, and the results we obtained confirm the accuracy of those obtained by Dr. Lunge and Dr. Treadwell. 3.564grms. of nitrate of potash (equal to 3grms. of nitrate of soda) were dissolved in 5½cc. of water, and the solution was made up to 100cc. by the addition of pure oil of vitriol. 3cc. of this were placed in the nitrometer, and 3cc. of pure oil of vitriol were afterwards added to rinse out the cup of the nitrometer. This liquid on being shaken up with the mercury yielded 24cc. of nitric oxide gas, which is just about the proper amount that should be obtained. (I notice Mr. Bayley says that from 3cc. of his solution of nitrate of soda only 7.8cc. of NO gas was obtained. There is some error here. Probably only 1cc. of the nitrate solution was taken instead of 3 as stated.) After expelling the 24cc. of NO from the nitrometer, the cup was rinsed out with water and afterwards dried with blotting paper, and every precaution taken to avoid the possible errors pointed out by Dr. Lunge in his paper. The acid and mercurous salt were now diluted with an equal bulk of water and shaken. At first no additional gas was liberated, but after standing some time an occasional extremely minute bubble of

would be of about sp. gr. 1.620. This yielded 10.70cc. of NO in the nitrometer. On removing this gas and diluting the remaining solution with an equal bulk of water in the nitrometer and agitating, no further gas whatever was obtained. I am quite satisfied that the results obtained by Mr. Bayley and his friend have been owing in some way to imperfect manipulation.

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Meeting held January 27, 1886, in the Mason College.

MR. CHARLES HUNT (TREASURER) IN THE CHAIR.

NOTE ON THE DETECTION OF METALS IN DRINKING WATER.

BY A. J. COOPER.

(Abstract.)

THE tests described in the following paper have long been used as means of qualitatively detecting the metals to which they respectively refer. The object of the experiments undertaken by the author was to ascertain the comparative delicacy of these tests, with a view to their application quantitatively.

The following table sets forth the results obtained:—

METAL.	REAGENT.	Depth of Liquid 3½ inches.	Depth of Liquid 14½ inches. Cylinder enclosed in opaque tube.
		1 part of metal detected in	1 part of metal detected in
Copper	K ₄ FeCy ₆	4,000,000 of water	11,750,000 of water
"	NH ₄ HO	1,000,000	1,950,000
"	H ₂ S	4,150,000	15,660,000
Zinc	NH ₄ HS	2,500,000	—
Arsenic	SH ₂	3,600,000	7,520,000
Lead	K ₂ CrO ₄	4,000,000	5,875,000
"	SnH ₂	100,000,000	196,000,000

gas could be seen by the aid of a magnifying glass ascending up through the liquid. The whole amount of such gas, after shaking the nitrometer and allowing it to stand 15 hours, was unmeasurable, and formed a minute bubble in the narrowest part of the tube, immediately below the tap. There certainly could not be more than what would probably measure 0.01cc. So that practically there was no further evolution of gas from the liquid after dilution. Another experiment was made, in which 2.5cc. of a solution containing 0.045grms. of nitrate of potash were added to one-and-a-half times its bulk of oil of vitriol (or 3.75cc.), thus making a solution which

ON THE CORROSION AND PITTING OF COPPER AND BRASS BY SALINE WATERS.

BY WILLIAM A. TILDEN, D.SC., F.R.S.,

Professor of Chemistry in the Mason College, Birmingham.

In the Philosophical Transactions for 1824 there is a paper by Sir Humphry Davy, under the following title:—"On the Corrosion of Copper Sheathing by Sea-water, and on Methods of Preventing this Effect; and on their Application to Ships of War and other Ships."

This paper contains an account of an experimental enquiry undertaken at the instance of the Commissioners of the Navy Board, and in co-operation with a committee of the Royal Society; and so far as I can ascertain, it represents the first attempt systematically to investigate the causes of the corrosion, and to find a remedy for the destructive action of sea-water. The results of this investigation are matters of history. Davy was led to apply the theory of electro-chemistry, and knowing that "chemical attractions may be exalted, modified, or destroyed by changes in the electrical state of bodies," he considered that copper, which is "only weakly positive in the electro-chemical scale, if it could be rendered slightly negative, the corroding action of sea-water upon it would be null." Davy's plan of protection consisted in attaching small pieces of zinc or iron to the copper surface; and there is no reason to doubt that so far as the protection of the copper from the attack of the sea-water was concerned, the plan was entirely successful. It failed in practice from the circumstance that the sheathing thus protected was found to become quickly loaded with an earthy deposit, upon which sea-weeds and barnacles gathered more abundantly than under ordinary circumstances when protectors were not employed.

Before Davy's time it had been "generally supposed that sea-water had little or no action on pure copper, and that the rapid decay of the copper on certain ships was owing to its impurity" (Davy, *loc. cit.*); but this opinion could not have been universally held, inasmuch as patents were taken out by Keir in 1779*, and by William Collins in 1807, for alloys of copper with zinc adapted to the manufacture of ship sheathing. In "Aikin's Dictionary of Chemistry" (dated 1807), under the articles *Brass* and *Copper*, the following passages occur:—

Brass is said "to be less subject to rust, and to be acted upon by the vast variety of substances which corrode copper with so much ease; and again "the principal objects of alloying copper appear to be to render it less liable to tarnish, and especially to be acted upon by common animal or vegetable substances, etc.; and Davy himself states that in some comparative experiments of his, he found that the copper containing alloy was attacked by sea-water less than pure copper.

In 1823—that is before the publication of Davy's experiments—a patent was taken out by Robert Mushet, for the manufacturer of a metal suitable for sheathing, by alloying copper with very small quantities (2oz. to 100 pounds) of zinc or tin.

The well-known patent for yellow metal, specially applicable for ship sheathing, was taken out in 1832, by Mr. George Frederick Muntz; but it does not appear to have been maintained that this copper zinc alloy would resist the action of sea-water better than copper. Superiority was claimed for it on the ground that it was cheaper, that it would roll at a red heat, and that ships sheathed with it would be kept cleaner, "because the zinc in the alloy corrodes entirely over the surface, and prevents barnacles, etc., attaching themselves to the bottom of the ship." ("Ure's Dict." vol. i. and Supplement, also Abstracts of Patent Specifications.)

Several other patents have been taken out for copper alloys suitable for ship sheathing. For example, one by John Revere in 1830 (No. 5892), for a mixture of 95 zinc to 5 copper. Another by Matthew Uzielli in 1830 (No. 5952), for an alloy of 100 copper with 5 to 7 parts of tin. And again in 1830, by Geo. Gwinnett Bompas. According to this inventor,

"copper and other metals and their alloys are preserved from oxidation, and rendered suitable for sheathing ships, by using such combinations of metals as will, in sea or saline water, just neutralise the corrosive action of the sea-water, by causing slight galvanic action." From 90 to 200 parts of zinc, alloyed with 100 copper, were recommended for sheathing.

It appears, therefore, to have been believed by many persons that pure copper was not the best material for resisting the action of sea-water, and even at the present time there can be no doubt that considerable difference of opinion exists upon this subject.

My attention was drawn to the matter about three years ago, and finding that the greater part of any knowledge that might exist upon the subject was in the possession solely of Admiralty officials and others, and had not been published, I thought it might be interesting, in a town where so much copper and brass are manufactured, to make known the results of my own observations and experiments. The only observations of any importance that I can find recorded are contained in the first volume of "Percy's Metallurgy", published in 1861, and this has long been out of print. In pages 506 to 517, it contains extracts from official documents relating to the loss per sheet per annum sustained by sheathing, and the results show very fully how variable is the action of sea water upon copper. This variation has generally been attributed to differences in the quality of the copper ("Impurities in Commercial Copper," see Abel and Field, *Journ. Chem. Soc.* 1862, p. 290; and Abel, *Journ. Chem. Soc.* 1864, p. 164), more particularly to the presence of lead, bismuth, and antimony. In these days of iron ships, copper sheathing is a matter of smaller importance than formerly.

One question then relates to a comparison of copper zinc alloys, with commercially-pure copper in their behaviour with sea and other saline waters; but there is another of equal if not greater importance, and that is as to the circumstances under which such unequal corrosion occurs as to lead to the formation of holes in ship sheathing, in the condenser tubes of marine engines, in locomotive boiler tubes, and the like.

For my own information I have made a great variety of experiments on the action of ordinary acids on copper and brass, and have compared the results with those of other experiments which have been published (Calvert and Johnson, *J. Chem. Soc.* 1866, p. 434; Pickering, *J. Chem. Soc.* 1878, p. 112).

It is stated in some books that finely-divided copper will dissolve in hydrochloric acid, with evolution of hydrogen. Not only is this the case, but I find, rather to my surprise, that rolled sheet copper is also slowly dissolved in boiling, strong hydrochloric acid evolving hydrogen gas. With this knowledge it is not difficult to explain the fact, long ago recognised, that brass is capable of being entirely dissolved in hot hydrochloric acid. The zinc is for the most part attached, and the residual spongy copper is then dissolved quite readily.

It was shown by Calvert and Johnson, in 1866 (*J. Chem. Soc.* [2], iv. 412), that an alloy of about equal weights of copper and zinc, immersed in strong hydrochloric acid at common temperatures, gives up in a few days nearly the whole of the zinc, leaving the copper behind in a spongy state. The experiments of these chemists were always conducted with cubes of the cast metals. Mine have all been made upon the sheet, about 1mm. thick; and although my results are not on the whole in conflict with theirs, they do not give in every case the same results. I found that sheet brasses of various composition resist the action of strong hydrochloric acid in the cold better than would appear from the result just mentioned. But a

* Keir, *Jas.*, 1779, 100 copper, 75 zinc, and 10 iron; Collins, *Wm.*, 1817, 100 copper, and 80 zinc. This was cited at the trial of Muntz's Patent.

very curious fact presented itself. I found that if the sheet was bent, a very rapid action set in at the bend, resulting in the disintegration of the metal at that part. After immersion for some weeks, the zinc seemed to have been removed, to a large extent, from the bent part, a brittle spongy mass remaining behind, whilst that portion of the sheet which had not been distorted, remained much less affected; and in the case of a brass containing about 70 per cent. of copper, it was scarcely attacked at all.

Probably all brasses consist of definite alloys, the crystals of which are embedded in an excess of zinc or copper. Bending or distortion of the brass may, therefore, cause the partial separation of the crystals from one another, and the formation of minute invisible cracks, which would admit the acid into contact with the interior of the mass, and so the chemical action would be promoted.

The action of weak hydrochloric acid and of solutions of chloride, is quite different from that of strong hydrochloric acid. The experiments of Calvert and Johnson recorded in the paper just quoted, relate to the action of sulphuric, nitric and hydrochloric acids of various strengths, on copper, zinc and tin, and in several brasses and bronzes. As the metals employed by these chemists were all laboratory specimens, cast and not rolled, and as there are several other points in their paper to which exception might be taken, I felt desirous of further investigating the question for myself, and the following experiments were therefore undertaken.

The metals used were of best selected copper, with commercially pure zinc. They are analysed qualitatively, to see that no unusual ingredient was present, and that the lead and iron which are contained in all brasses, did not exceed the usual minute quantity. Traces of nickel were found in one or two cases. The copper was quantitatively estimated by the electrolytic process, indicating the proportions given in the tables below, which embody some of the results observed.

The metals were polished by rubbing with sand and fine emery. No acid was used to clean them.

It will be noticed that in the three brasses D, E, F, the constituent metals are dissolved away in proportions which are practically the same as those in which they occur in the alloy. In the poorer one C, the zinc is attacked at a much greater rate than the copper; but when the total amount of the attack is considered, it is plain that this mixture is better adapted to withstand the action of weak hydrochloric acid than either of the three which contain more copper.

The action of diluted nitric acid, containing about 6 per cent. of HNO_3 , is shown by the figures in the table below to be different from that of hydrochloric acid, for in this case the attack is greater as the proportion of zinc is greater, and the action of the acid on copper and on the best brass is about the same. The acid employed by Calvert and Johnson was about twice as strong as mine; but their metals were immersed during only fifteen minutes. They point out, however, that the action of the acid is comparatively violent in all the alloys containing an excess of zinc, though much less vigorous in those which contain an excess of copper.

ACTION OF DILUTE NITRIC ACID.

1 VOL. (SP. GR. 1.42) WITH 15 VOLS. WATER.

TEMPERATURE 13° to 15° .

	Loss of Weight per Square Centimeter. 23 days.	Ratio of Copper to Zinc in dissolved portions.
Copper .....	.063grm.	Cu 100 : 0 Zn
Brass C .....	.230	100 : 124
„ D .....	.110	100 : 90
„ E .....	.130	100 : 171
„ F .....	.057	100 : 65
Bronze .....	.031	10 : 12 Zn+Sn

ACTION OF DILUTE HYDROCHLORIC ACID (7 PER CENT.).

TEMPERATURE 13° to 15° .

	Percentage of Copper by Analysis.	Loss of Weight per Square Centimeter.		Ratio of Copper (taken=100) to Zinc, etc.	
		In 14 days.	In 21 days.	In Original Metal. Copper. Zinc.	In Dissolved Portion. Copper. Zinc.
Copper.....	—	.187grm.	.239	100 : 0	100 : 0
Brass C	58.64	—	.001	100 : 70	100 : 800 (!)
„ D	61.35	.009	.022	100 : 63	100 : 75
„ E	61.98	.020	.020	100 : 61	100 : 61
„ F	70.22	.036	0.42	100 : 42	100 : 35
Bronze..... (Coinage metal.)	93.31	.172	.229	100 : 7 (zinc and tin)	100 : 35

In these results the protective influence of the zinc in the alloy is very manifest. Zinc appears to act in a similar though less effective manner. The conclusions arrived at by Calvert and Johnson as to the action of dilute hydrochloric acid upon brasses, were similar to these, though, inasmuch as their metals were immersed for one hour only, I think their results less satisfactory. My results also agree in the main with observations made by David Mushet about 1822, and afterwards published in the *Philosophical Magazine* for June, 1835, under the title, "On the Immersion of Copper for Bolts and Ship Sheathing in Muriatic Acid as a Test of its Durability."

It occurred to me that when the action of the acid had gone on some time, a portion of the dissolved copper might perhaps be redeposited in exchange for zinc. But from experiments made with the object of testing this point, I came to the conclusion that in nitric acid solutions, so long as there was abundance of free acid present, no appreciable redeposition occurs. When the acid is allowed to become saturated, the surface of the immersed brass becomes coated with a remarkable nearly-black crystalline and highly-lustrous film, which makes its appearance at first near the surface of the liquid, and gradually extends downwards

till the whole plate is covered. It probably consists of oxide.*

I have examined the effect of sulphuric acid upon the same metals, with the following results. No action could be observed below about 150°C . The acid was diluted with water, in accordance with the formula $\text{H}_2\text{SO}_4\cdot 2\text{H}_2\text{O}$.

ACTION OF $\text{H}_2\text{SO}_4\cdot 2\text{H}_2\text{O}$.

TEMPERATURE, 185° TO 190° ; TIME, $\frac{1}{2}$ HOUR.

	Loss of Weight per Square Centimeter.
Copper.....	·062
Brass C	·102
„ D	·040
„ E	·068
„ F	·063
Bronze	·115

The resulting solutions were all black from the formation of sulphide, and on standing, deposited crystals of CuSO_4 . It will be noticed that of the brasses the poor one is the most attacked, and rather singularly the bronze is even more affected.

It is obvious that the extent to which a metal is attacked, depends not only on the composition of the metal itself, but also on the chemical character of the corrosive agent.

Having made these preliminary experiments, I proceeded to inquire into the action of sea-water.

When a piece of copper is immersed in sea-water, the liquid soon exhibits a bluish cloudiness, and after a time, if a portion of the metal is exposed to the air, it becomes covered with a green crust. The composition of this crust was long ago investigated by Sir Humphry Davy (*“Works,”* vol. vi. p. 275), and an explanation given of the process by which it is formed. When the metal is completely immersed in acidulated water, this crust is never formed, the metal dissolving away without deposit. In solutions of chlorides, such as exist in sea-water, the crust is formed to some extent below the surface of the liquid, though in much larger quantity at the surface, and especially upon any part which is liable to be alternately wetted with water and dried in the air.

The action of water and of various saline solutions upon copper has already been to some extent investigated by Dr. Carnelley, and an account of his experiments was read to the Chemical Society of London in 1876 (*Jour. Chem. Soc.* 1876, ii. 1). Dr. Carnelley found that even distilled water, in the presence of air, has a perceptible action upon copper and a minute quantity of the metal is dissolved. He also made a quantitative comparison of the action of solutions of various salts, and showed that the chlorides are amongst the most active. But I could not find that he had given attention to the causes of the inequality of action on the surfaces of metal exposed to the action of salt solutions.

Sea-water is a solution of many salts, together with some dissolved oxygen and carbonic acid. In the first instance I had rather hastily jumped to the conclusion that the ingredient most destructive in its action upon metals must be the chloride of magnesium. I thought it best, however, to test this idea by experiment. Accordingly, chlorides of sodium,

calcium, and magnesium were prepared in a state of chemical purity and free from acid. These salts were dissolved in distilled water, in the proportions in which they occur in sea-water, and strips of the same sample of brass were placed in the solutions, so that a portion of the metal was exposed to the air above the surface of the liquid. The metal in chloride of calcium and in chloride of magnesium remained for many days quite untarnished, whilst that which was immersed in the sodium chloride became very soon encrusted near the surface with green oxichloride, and the liquid grew turbid from the formation of a bluish-green precipitate, becoming at the same time alkaline to test-paper. Obviously the chloride of sodium was by far the most active. I thought this might be due to the much larger quantity of the salt in solution. I therefore made another solution of magnesium chloride of the same strength as the sodium chloride (viz., $26\frac{1}{2}$ grms. to the litre), and placed in it another strip of the same brass. Still there was very little effect. Magnesium chloride is, therefore, evidently not the chief active ingredient of sea-water, and is, in fact, greatly inferior in activity to sodium chloride. This was further confirmed by adding to that solution of magnesium chloride which had been found to be almost inactive a quantity of sodium chloride, when in the course of a few hours the attack commenced.

The action of a chloride upon copper in contact with air appears to depend not solely on the disposition of the copper to combine with chlorine and with oxygen, but is dependent on the affinity of the metal of the chloride for oxygen, and is greater in the case of the alkaline chlorides than in the chlorides of the alkaline earthy metals.† Magnesium chloride probably acts like a very weak hydrochloric acid. As to the influence of the air there can be no doubt. Brass may be boiled with a solution of salt for any length of time without alteration, provided air is entirely excluded. Practical experience in other directions led me to the same conclusion. It has also been long observed that the corrosion of ship sheathing is generally much the worst near the water-line.

The question to which I have especially directed my attention is the remarkable pitting which occurs in brass condenser tubes of marine engines, and in brass and copper tubes generally employed in connection with salt waters. This peculiar pitting, which so frequently leads to perforation of the tube, is a phenomenon unfortunately familiar to manufacturers, but so far as I am aware has not hitherto received adequate explanation.

To account for this pitting a number of hypotheses presented themselves, such as imperfect intermixture of the copper and zinc, the presence of too large a proportion of impurity in the shape of iron or lead, the presence of particles of iron imbedded, during the process of drawing, in the substance of the tube. It was also suggested that vessels lying in dock might take up acid water, which would attack the metal chemically. A long consideration of these and other circumstances led me to the conclusion that even if some of the conditions just mentioned existed commonly enough to account for the frequent occurrence of corrosion, they could not explain the remarkable localisation of the action. The idea occurred to

* Copper is superficially bronzed by formation of oxide when immersed in solution of salt, mixed with potash. Wetzlar.—Schweigger's Journal, 49, 188.

† Davy found that strong salt solutions did not act upon copper, although when diluted they act promptly. I too have noticed that strong solutions of salt act much less vigorously than weaker ones. The only explanation I can give of this fact is that the strong solutions absorb less oxygen than those more dilute. I find from Carnelley's results (*loc. cit.*) that the action of potassium chloride upon copper is somewhat greater than the action of sodium chloride, and this agrees with my hypothesis.

me, as to Davy, Percy,* and others who have reflected upon the subject, that the chemical action of the saline water would be heightened if we imagine the addition of an electrical action, due to the contact of other less positive metals, or other substances in contact with the brass. The difficulty was to account for the existence of such matters in the interior of the condenser tubes.

To test the possibility and the extent of probable voltaic action, as well as the relative powers of different metals to withstand attack of sea-water, the following experiments were made:—Strips (5×2 inches) of the various metals, the composition of which has already been given, were cleaned by rubbing with fine sand-paper. No acid or other liquid was used. They were then placed in beakers, and were about three-fourths covered with sea-water, and, in order to promote the action, kept at a temperature of about 40° C. during seven hours every day (except Sundays). Every few days the loss by evaporation was made up by additions of distilled water. The experiments were started on July 9, 1884, and the metals were removed on June 3, 1885—occupying about eleven months.

It should also be added that the water in the beakers was emptied out several times and replaced by fresh sea-water. To make the results more intelligible to readers of the paper, the metals ought to have been weighed and the loss of weight determined. On removing them for examination, nearly all were covered by a green crust, which was thickest at the top, where the metal had frequently been exposed to the air from evaporation of the solution.

YELLOW METAL D, CONTAINED 61·35% COPPER.

1. *Alone*.—Surface clean and action scarcely perceptible.

2. *Bound with Platinum Wire*.—Very clean. Slight indications of electrolytic action, the course of the wire on one side being marked by small bright patches of deposited copper.

3. *Bound with Copper Wire*.—Slight pitting visible only under a lens. Similar to 1.

4. *Bound with Iron Wire*.—Discoloured with thin films of copper, but otherwise sound. Slightly decayed at bottom edge.

5. *A Spot of Tin attached to Surface*.—Copper deposited all round the tin.

6. *One End Immersed in Black Oxide of Copper*.—The part immersed in the oxide is smooth and polished, as though inequalities had been filled up; but just above the strip is roughened and patches of copper deposited.

A piece of tube treated in the same way was much attacked near the surface of the solution.

7. *One End Covered with Red Lead, Pb₃O₄*.—The part immersed in the oxide looks smooth, but the whole upper part is on one side covered with dots of deposited copper.

BRASS E = 61·98, SAY 62% COPPER.

8. *Alone*.—Clean looking, but under the lens seen to be finely honeycombed: much more attacked than any of the preceding.

BRASS F = 70·22% COPPER.

9. *Alone*.—Finely honeycombed, even worse than 8.

10. *Oxidised Superficially by Heating One End, the other Polished*.—Corroded all over: effect of green incrustation at the top very marked.

COPPER.

11. *Alone*.—Discoloured all over; patches of red oxide, and deeply pitted.

12. *Bound with Platinum Wire*.—Worse than 11; almost entirely covered with crystalline red oxide.

13. *With Brass Wire*.—About the same as 12, the course of the wire being specially marked by red oxide.

14. *With Iron Wire*.—Discoloured, much the same as 12 and 13.

The patches on all these seem to be due chiefly to the action of the green crust.

15. *Spot of Tin near One End*.—Surface pretty clean and not attacked except where incrustation had been allowed to form.

BRONZE (CARRIAGE METAL).

16. *Alone*.—The whole surface finely crystalline (*moirée*); corrosive effect of crust very marked.

17. *With Platinum*.—Much discoloured, black.

18. *With Copper*.—Same as 17.

19. *With Iron*.—Similar to 16.

20. *Sheet of Bronze and Sheet of Yellow Metal D in same liquid in contact with each other*.

Yellow metal not perceptibly attacked, bronze slightly corroded.

The conclusions I draw from the experiments I have described are somewhat as follows:—

1. Copper and brasses containing more than about sixty per cent. of copper are attacked by sea-water and chlorides generally more rapidly than brasses containing about that proportion of copper. I am aware that this conclusion may not be acceptable to everyone, but it is an opinion I have formed after a good deal of consideration, and it appears to have been the opinion of the late Dr. Calvert, to whose paper reference has been made.

2. One cause of unequal corrosion leading to pitting is the voltaic action which is set up in consequence of contact with particles of other less positive metals or metallic oxides. In my experiments, oxide of copper appears to be, in the presence of salt water, one of the most active of these substances.

3. Another, and probably the most destructive agent of all, is the green crust which is produced in the manner I have described, its most abundant formation occurring when the surface is alternately wetted with salt water and dried in the air. The action of this substance may be partly due to its electro-negative character, resembling in this respect oxide of copper; but I incline to the belief that the greater part of its action is a chemical one, aided by its porous texture, in consequence of which it readily absorbs moisture and air. And I believe that the holes in sheathing and in condenser tubes supplied with sea-water are formed most generally in consequence of the formation of patches of this substance. The process is easy to imagine. Suppose the flow of water through the tubes of a condenser to be interrupted for any reason. The tubes lie in a horizontal position and do not drain completely. A small quantity of sea-water is left which speedily dries up in spots, which necessarily lie along one side of the tube in the position in which the holes are most commonly found. Then the moist salt, with the oxygen of the air, acts on the surface of the metal, producing a spot of oxichloride, which remains attached to that part and continues to act electro-chemically when under the surface of the water, chemically by absorption of oxygen when dried up.

It is quite possible, however, that in some cases the process may be started by the presence of other and foreign substances. Suppose a particle of iron to

find its way into one of these tubes. Wetted with water, it at once begins to rust, and will attach itself firmly to the inner surface of the tube. So long as any iron remains unoxidised the effect is to prevent corrosion of the brass, and actually to protect it for some distance all round in accordance with the principle originally established by Davy. But directly the whole of the iron is converted into oxide, the process is reversed. The crust of oxide formed upon the brass and closely adherent to it causes the action of the salt water to be greatly intensified, and the formation of green oxichloride proceeds rapidly. It may also be remembered that when cast-iron is attacked by salt water it leaves behind it a skeleton of carbonaceous matter which probably contributes to the effect. Several other metals would be capable of producing the same action. That iron is actually capable of causing corrosion I have proved by experiment. Pieces of brass sheet and tube were bound with iron wire and exposed to a current of hot sea-water for several weeks. In about two days the iron was completely oxidised, and distinct corrosion then became manifest upon the brass, resulting in the formation of an irregular groove in the metal along the line of the wire, a process that must have resulted in a hole if the experiment could have been continued long enough. The holes in the defective tubes extend, almost without exception, along the lower internal surface, upon which particles could collect. In one or two cases, out of a large number I have seen, in which the perforation was not confined to the lower side, it can easily be accounted for by supposing the offending particle to be cemented to the side by the earthy deposit which is thrown down continually from the water.

As to sheathing, I have already referred to the fact that the corrosion is most marked about the water line, a circumstance which is quite in conformity with the hypothesis that the action is mainly due to the incrustation.

4. Of course it is not maintained there may not be occasional instances of pitting arising from the existence of flaws in the metal. Undoubtedly this happens now and then, but I do not believe that it is a frequent cause. I was not prepared to find that bending of the metal would alter the rate of attack, but evidently this should be taken into account.

There are several practical lessons of importance which may be learnt from an inquiry into this subject. The chief of these I take to be the importance of keeping the surfaces of copper and alloy as clean as possible. In the case of condenser tubes I should imagine there would be no serious difficulty about clearing them out every time a vessel goes into port, and before they have time to dry inside by brushing out with a stiff brush. Locomotive boiler tubes are in different circumstances, and, moreover, the corrosion noticed in such case is not generally due so much to the salts in the water used as to the overheating and burning of portions of the tube, which became so thickly encrusted with calcareous deposit as not to be in contact with the water.

Another point is the desirability of avoiding distortion of the metal by bending, boring or otherwise. Holes for rivets should be punched or bored out quite clean without altering the form of the plate or tube. And lastly, contact with other metals should never be permitted in structures which are to be used in connection with sea-water or well waters containing large quantities of chlorides and other salts. Solder, whilst itself undergoing rapid destruction under such circumstances, exercises a protective influence. But copper should not be placed in contact with gun-metal, bronze or brass, as it will assuredly suffer.

Dr. Percy was good enough to show me lately an excellent example of the effect of such contact. A copper condenser tube, although quite round elsewhere, had become perforated close to the point of contact with a gun-metal dividing plate or partition.

Some of the tubes on the table show on the outside, near the ends, where they have been in contact with the condenser casing, the commencement of similar action.

In conclusion, I desire to say that I am fully conscious of many deficiencies and omissions in this attempt to explain these perplexing phenomena. I should like, for example, to include phosphor bronzes in my experiments, and this, perhaps, I may be tempted to do hereafter.

Finally, I desire to express my best thanks to those gentlemen who have kindly supplied me with specimens or material, especially to Messrs. Elliott, Heaton, Allen, Everitt & Sons, and to Mr. Clifford.

DISCUSSION.

Mr. F. MUNTZ asked for an explanation of the fact that ship sheathing was often so unequally worn that portions were full of holes, whilst the remainder was perfectly sound.

Mr. ROWLEY inquired as to the effect of tinning condenser tubes. He had found that in acetic acid tin was acted upon very slightly, whilst copper was strongly attacked.

Mr. ENOCH EVANS had understood Dr. Tilden to say that holes should be punched out, not drilled. Having been under the impression that it was better to bore the necessary holes than to punch them, he would be glad of information on that point. He thought the effect of impurities in the metal would account for some of the effects described in the paper.

Mr. DAWSON said he had seen ocean-going steamers with some of the tubes tinned inside, and these had gone much worse than copper. In some cases tinned tubes would stand, and in some cases they would not. He also knew of cases in which, on arriving in port, the greatest care had been taken to wash out the tubes with spring water, so that it was impossible that salt water could have been left lying in the tubes in the manner described in the paper. He was also of opinion that the presence of foreign particles imbedded in the substance of the tube was, in some cases, the cause of perforation.

Dr. TILDEN, in replying, referred the perforation of sheathing chiefly to the action of the green crust, which, from circumstances impossible to contest, was formed and adheres in patches. This was contrary to an opinion formerly current that the incrustation had a protective influence. He had also considered the question of tinning condenser tubes; but, although the surface was protected by a coating of tin as long as the latter was intact, yet directly the brass from any cause became exposed, the action of the sea-water was greatly increased.

With reference to the important question as to impurities in the shape of particles of carbon or of foreign metals imbedded in the brass, he had examined a great many samples of the metal with the object of detecting them, and had failed to find anything of the sort, except in one solitary instance in which a particle of iron was pressed into the surface of the tube. Many samples of metal had been treated with dilute nitric acid till almost dissolved away, and he had always found on examination at intervals that so long as the metal was completely immersed in the acid, and kept from contact with anything else, the sheets were thinned down uniformly, and exhibited all over the surface a finely

crystalline structure, and there was no inequality or localisation of the action.

As to the relative advantages of punching or drilling, he had no opinion to offer. All he meant to indicate was that the sheet or tube should not be bent or distorted in any way.

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BUSINESS FOR NEXT MEETING.

March 2nd.—Professor Mills, D.Sc., F.R.S., "On Viscosity Determinations."

Mr. C. J. Ellis, F.C.S., "On Maumené's Test for Oils."
Mr. R. T. Thomson, "On the Determination of Oxide of Iron and Alumina in Commercial Phosphates."

Notices of papers and communications for the meetings to be sent to the Local Secretary.

The Fourth Meeting of the Session was held in the Rooms, 207, Bath Street, on Tuesday, 2nd February, 1886.

MR. J. NEILSON CUTHBERTSON IN THE CHAIR.

ACTION OF CHLORIDE OF SODIUM ON SOLUTIONS OF SOAPS.

BY T. N. WHITELAW.

In the methods most commonly employed to manufacture soaps, the action of sodium chloride on solutions of soap plays an important part. With small quantities of sodium chloride soaps may be rendered more liquid in the boiling operation, and by the addition of larger quantities the soap can be separated from excess of water and from impurities, while the prolonged boiling with salt solutions is often adopted to bring soap to a certain strength for special purposes, or to obtain a hard soap by thus withdrawing water from it.

It has been long well known that soaps are insoluble in solutions of salt of a certain strength, and that when boiled with such solutions the amount of water retained by the soap varies inversely as the quantity of NaCl in solution, but no experiments have been published defining this action.

I have endeavoured to contribute something towards a more definite knowledge of this matter. For this purpose I selected tallow and palm oil, the soaps from which behave differently with solutions of salt; the greater number of oils used in soap-making resembling tallow, while cocoa-nut oil is more like palm-nut oil in the manner in which its soap solution behaves with NaCl. Tallow and palm-nut oil soaps are therefore selected as affording types of the manner in which solutions of soaps behave with salt.

6grms. of fatty acids from tallow and palm-nut oils respectively, were saponified in a flask of about 250cc., separated with excess of caustic soda from solution, and after cooling until the soap curds had solidified, the caustic soda liquor was allowed to drain off.

The soaps obtained were dissolved in 100cc. of distilled water, and a weighed quantity of pure NaCl added, enough to obtain distinct separation of the soaps in small curds, then water was added in small quantities from a burette, and the soap solution brought to the boiling point and well agitated after each addition, a cork provided with about 14in. of glass tubing preventing any loss of water during the momentary boiling. Certain fairly well marked points were observed during the addition of water.

With a certain strength of solution the soap grains were distinct and separate, without any tendency to settle out fluid soap. With a further addition of water the grains became softer, and a thin layer of fluid soap could be observed settling beneath them. With the further addition of water the grains became entirely fluid, and the fluid soap occupied more and more of the total fluid volume as more water was added, until a point was reached when the fluid becomes clear and bright, and the soap completely dissolved. The points of distinct separation in grains, and the points of complete solubility in boiling solutions, are as follow:—

	Tallow Soap.	Palm-nut Oil Soap
Separates in distinct grains,		
NaCl per cent.	6.5	18.0
Clear hot solution (100° C.)		
NaCl per cent.	3.0	13.0

On slowly cooling those solutions, the tallow soap remained completely soluble, and when cold formed a firm jelly, while the palm nut oil soap separated as it cooled into a thin layer on the surface of the salt solution. It was found that tallow soap is nearly as soluble in the cold as in the hot solution of salt, but that while palm-nut oil soap is soluble in boiling water containing 13 per cent. of NaCl, it is insoluble in cold solution of 3 per cent.

It is important to notice the composition of the soap as it is separated in distinct grains from salt solution, and also when the grains, slightly liquefied, float on a thin layer of liquid soap above the salt solution. In the first case we have an ordinary soft curd soap, and in the second case, if we consider the subnatant salt solution removed, we have soap grains washed by a solution of soap, and both the method of purifying with salt and purifying with soap are adopted on a large scale to obtain pure soap of a definite composition.

The following are testings of soap thus settled from salt or curd soap; and soap settled from soap, or fitted soap:—

	Palm-oil Curd Soap.	Fitted Soap (Tallow, Resin).
H ₂ O	31.38	31.4
Na ₂ O	7.13	7.0
Fatty anhydride	59.82	60.3
NaCl	1.67	1.3
	100.0	100.0

To investigate the action of more concentrated solutions of chloride of sodium upon soaps, the same flask, with cork and tube to prevent loss by evaporation, was employed. The mixture of salt solution and soap grains was brought to the boiling point and well agitated from time to time, then this having been done for a definite time, the soap grains were quickly filtered from the salt solution through wire gauze, and spread like butter upon an ordinary towel of firm texture, then well pressed to remove water. By this means the soap was obtained with a varying amount of NaCl, but fairly free from mechanically mixed water.

A soap from a good quality of olive oil, such as is used for Turkey-red dyeing, when so treated for 30 minutes, with an 8 per cent. solution of salt, retained 31.6 per cent. of water, with a 17 per cent. solution it retained 25.7 per cent., and with a hot saturated solution it retained 19.1 per cent.

Underneath are analyses of various soaps after 30 minutes' treatment with a hot saturated solution of salt, and one of soap after 60 minutes' treatment, to find if more prolonged treatment tended to still further reduce the quantity of water retained by soaps. During this operation the soap grains become very small and hard, and when pressed between the folds of a towel they solidify at once, and are readily detached from it.

	Olive Soap. 30 min.	Olive Soap. 60 min.	Tallow Soap. 30 min.	Palm Nut. 30 min.
Fatty anhydride.....	67.9	67.38	64.49	66.4
Na ₂ O.....	7.8	7.75	7.64	9.9
H ₂ O.....	19.1	19.11	16.91	18.8
NaCl.....	5.2	5.16	10.93	4.9
	100.0	100.00	100.00	100.0

	Cotton Oil.	Castor.
Fatty anhydride.....	62.4	31.3
Na ₂ O.....	6.4	3.7
H ₂ O.....	17.2	48.3
NaCl.....	14.0	16.7
	100.0	100.0

The NaCl was obtained by difference.

It will be seen from the above that prolonged boiling did not reduce the quantity of water retained by the soap after 30 minutes' treatment. We have therefore here reached a limit to the action of sodium chloride in withdrawing water from soaps.

If we consider the chloride of sodium in the above analyses to be mechanically mixed with the soaps, we obtain by calculation the following percentage amounts of water in the hydrated soaps:—

	Soap.	Water.
Tallow Soap.....	80.9	19.1
Olive-oil Soap.....	79.8	20.2
Palm-nut Oil Soap.....	80.2	19.8
Cotton-oil Soap.....	80.0	20.0

Castor oil behaves differently from most other oils with solutions of salt; it is soluble in very concentrated solutions, and, as the above analyses shows, it retains a large quantity of water when treated with saturated solutions.

Viscosity of Soap Solutions.—I have also made some experiments to investigate the nature of solutions of various soaps, to determine with what quantities of water they tend to gelatinise, and what are their relative viscosities. The solutions of soaps exhibit important differences which afford indications as to their purity, and as it is in the state of solution that soaps are used, their nature in this state has a special interest. For most uses the value of soap depends largely on its quality of lubricating, of allowing a fabric to be rubbed with as little wear as possible, and in the operation of milling, where the aim is to cause the fabric to shrink by submitting it to pressure and rubbing, soap is employed chiefly as a lubricant, the goods being washed previous to the operation. For certain uses, therefore, it seems desirable to consider the differences of soap solutions in viscosity, as those differences are very marked, and small quantities of certain soaps may do the same work as large quantities of others.

Solutions of various strengths were made from soaps of the following oils, and after allowing those solutions to stand for 24 hours, an attempt was made to determine by observation the point at which the

solution ceased to form a jelly; the points determined were as follow:—

Green olive (sulpho-carbon).	1 in 18	water
Olive oil (old)	1 in 50	"
Cotton oil	1 in 100	"
Palm nut	150	"
1 resin, 3 tallow		
Tallow	200 to 250	"
Palm oil		"

This point was at any time rather difficult to determine, and tended to vary with the length of time the solutions were allowed to stand.

To compare the viscosity of the various solutions, a 50cc. pipette was used, from which water took 28.2 seconds to flow. The time of efflux for the soap solutions was then determined, having previously shaken them to destroy their gelatinous structure. Temperatures of solutions 50° F. The following points were noted:—

Soaps.	
Green olive oil (sulpho carbon)	1 in 50 water took under 30° secs.
Green	1 in 120 " " " 28.4 "
Cotton oil	1 in 320 " " " 30.4 "
Palm-nut oil	1 in 320 " " " 29.5 "
"	1 in 700 " " " 28.5 "
Pale soap	1 in 700 " " " 28.5 "
"	1 in 600 " " " 30.2 "
Tallow	1 in 700 " " " 29.5 "
Palm oil	1 in 700 " " " 29.5 "

The above list is sufficient to indicate that from this mode of testing soap solutions some light may be thrown on the nature of the fatty bodies from which soaps are made, and to suggest the propriety of selecting soaps for certain purposes according to the viscosity of their solutions.

DISCUSSION.

Prof. MILLS asked if Mr. Whitelaw had made any experiments with thickened rape oil and cotton oil, and whether soaps made from these separated out according to the same law as soaps from the other common oils?

Mr. HUTCHESON suggested that Mr. Whitelaw should make some experiments on the viscosity of soap solutions with fixed quantities of different soaps in varying quantities of water.

Mr. CHRISTIE asked if the author had given any attention to the relative melting points of the fats used for making his experimental soaps? According to his own observations, soaps made from fats containing oleine or oleic acid, were more difficult to salt out than those made from hard fats such as tallow. An intimate relation undoubtedly existed between the proportion of oleine in a soap and the quantity of salt required to throw it out of solution. Castor and cocoa-nut oils, consisting almost entirely of a fat resembling oleine in character and reactions, produced soaps most difficult to salt out. He thought that the results of the author's experiments on olive-oil soaps were not reliable, owing to the absence of any data as to the percentage of stearine in the olive oil. Judging from the results obtained, he should say that an Italian oil had been used containing far more stearine than Malta, Spanish, and Mogador olive oils did. Some of the latter formed soaps so difficult to salt out that one might almost class them with castor oil rather than with such olive oils as were used by the author. He was of opinion that soap solutions declined in viscosity as they contained less stearine, even though there was a corresponding increase in the amount of oleine present. He had used 10 per cent. solutions of oleine soap which would remain fluid for weeks at ordinary temperatures.

Mr. WHITELAW: I have not seen thickened rape and cotton oils, and have no experience of soaps

and anyone interested in its manufacture or uses should read an article in the *Mechanical World*, 25th March, 1885. If not desirous of making liquid carbon-dioxide, the gas could be compressed in suitable vessels to 100 or 200lb. per square inch, and it would, I am sure, find a ready market.

4. *Ammonia-soda Process.*—The CO_2 required in this process for the production of bicarbonate of ammonia is generally obtained by burning limestone in specially-constructed kilns. As only a 25 per cent. gas by volume can on an average be obtained, it necessitates extra pumping. A supply of CO_2 , such as could be got from the distilleries, would be of great value to a maker of this article, and it would almost constitute as great an advantage to be close to a good supply of it as to that of the rock-salt.

5. *Decomposition of Alkali-waste.*—In 1859, Mr. Gossage, and, in recent years, Messrs. Schaffner and Helbig, have taken out patents for the recovery of sulphur from alkali-waste, and which, at their respective times, were looked upon as valuable inventions. In both instances, what militated very much against the success of the process was the want of a good supply of CO_2 , as the reactions involved did not proceed smoothly with CO_2 made from coke. A supply of waste CO_2 from the distilleries would, if available, contribute much to their success.

In many processes wherein the CO_2 from the burning of limestone or coke is used, it would be very beneficial to be able to raise the per cent. of CO_2 to, say, 50 or 60 per cent., and this would not be a difficult matter if a supply of this waste CO_2 were available.

The processes for the manufacture of bicarbonate of soda, aerated waters, or liquid carbon dioxide could be undertaken by either the distiller or the chemical manufacturer, the others only by the latter.

No doubt many will think the supply would not be eligible for chemical manufacturers, as it would have to be conveyed to an inconvenient distance. In answer to this, I may state that the largest distilleries are, as a rule, in the large towns—*i.e.*, London, Glasgow, Liverpool, Edinburgh, Dublin, and Belfast—and contain chemical works close at hand. In Glasgow we have, situated close together, the Port Dundas and the Dundas Hill distilleries, and within 200 yards are two of the largest chemical works in the city. If we increase the distance only a little further, we embrace St. Rollox and a large number of other works. To any of these works it would not be difficult to convey the CO_2 , either through pipes or in tanks; and even supposing there was not a chemical work within convenient distance of a distillery, I contend that where there is a large supply of gas it would justify a manufacturer in erecting a work within such a distance. We have an analogous case in the tar distillers, who erect their works in close proximity to gasworks.

Another objection which some may advance, is that the supply of CO_2 would be intermittent. This is accounted for by the fact that the Inland Revenue authorities do not allow a distiller to conduct the mashing and fermentation at the same time as he is working the stills; and, as the latter operation lasts two days, there is no fermentation going on during this time, and consequently there could not be a supply of CO_2 .

I do not think this is a strong objection, as the gas could be stored and used as required, like ordinary coal-gas.

Quantities Available.—We come now to the most important factor in the above proposal—namely, the quantity of CO_2 which is available—1st, from a single distillery, and 2nd, from the total quantity of alcohol manufactured in Great Britain and in Ireland

—and I hope to convince the most sceptical that it certainly (in some cases) is sufficiently large to be of value to chemical manufacturers.

The weekly production of one distillery in Glasgow, and also in Edinburgh, in good times will average 50,000 gallons of proof spirits per week. This corresponds to a yield of 1,764,600 cubic feet of CO_2 at 0°C . and 760mm. Reducing this volume to weight, we have 216,600lb. or 96.6 tons. There are several other distilleries whose production falls little short of these just mentioned. Now, in the second case, the total production for Great Britain and Ireland in 1883 amounted to about 25,000,000 gallons of proof spirit, so we shall have to multiply our previous figures by 500, and it corresponds in weight to 48,300 tons of CO_2 per annum.

We shall now try to get some idea as to what the above quantities of CO_2 correspond to when worked up into materials mentioned previously.

We have mentioned that 96.6 tons are produced per week at one distillery; this would give weekly—

Bicarbonate of soda	368 tons, calculating 100%
Bicarbonate of ammonia ..	173 " " "
Alkali waste, Schaffner and Helbig	158 " " pure CaS
Alkali waste, Gossage	158 " "
Liquid CO_2	96 " "

As regards the amount of aerated water to which this quantity of gas corresponds, I should imagine it would supply all the makers in the United Kingdom. By multiplying these figures by 500, we get the yield for each of the above articles, corresponding to the total make of the three kingdoms per annum—

Bicarbonate of soda	181,000 tons.
Bicarbonate of Ammonia ..	86,000 "
Alkali waste, Schaffner and Helbig ..	79,000 "
Alkali waste, Gossage	79,000 "
Liquid CO_2	48,000 "

I think that the above figures clearly demonstrate that the waste CO_2 from one distillery is sufficient to keep a large work supplied.

We shall in the next place try to arrive at some idea as regards the money value of gas from one distillery.

To produce 96.6 tons of CO_2 from limestone and HCl , there would be required of the former 219 tons at 100 per cent.; of the latter 533 tons at 30 per cent.

Taking the limestone at 6s. per ton, we have	£65
Taking the HCl 30% at 2s. per cwt. ..	1066
Total for limestone and HCl	<u>£1131</u>

We shall not add to this the cost of labour, apparatus, etc.; but just take the sum as it stands—£1131—as the value of 96.6 tons of CO_2 made in the usual way. To err on the safe side, we shall divide this number by 4, and we get roughly £280 as the value of this quantity of gas per week; so in one year it should add £14,560 to the revenue of one concern. Taking the production of the three kingdoms, we have as the value of CO_2 wasted, £140,000 per annum.

Taking the cost of production from limestone and HCl , the CO_2 should in reality be almost as valuable as the alcohol produced.

The average cost of one gallon, or 9.19lb., of proof spirit=2s.; therefore 1.0lb.=2½d.

To produce 1lb. of CO_2 from limestone and HCl , there is required for raw material 1½d., and adding the usual charges for labour, plant, etc., it could not be sold at a profit under 2d. per lb.

In conclusion, I may say that the iron masters, in order to recover a mere trace of ammonia from their waste gases, have found it profitable to erect a most expensive plant, and one which requires a consider-

able amount of labour in its working, and is difficult to keep in order. There could be little difficulty to overcome in the recovery of the waste CO_2 compared with that of the ammonia, and the expense could not be nearly so great; but the profit should be considerably larger. It is a pity to see such a valuable by-product wasted, and it is to be hoped that before long some enterprising firm, either of distillers or chemical manufacturers, will be able to make use of it.

It is only by making the most of what we have that we shall be able to compete more favourably with foreign countries, and pass more comfortably through such serious depressions of trade as we have been experiencing for some time past.

DISCUSSION.

Professor DITTMAR said that Mr. Fawsitt's paper was very suggestive and worthy of closest attention. The "fermentation carbonic anhydride" was particularly valuable on account of its purity, and especially on account of the absence of those undefined substances which give the peculiar smell to carbonic anhydride prepared from limestone. The idea of using this fermentation carbonic anhydride was not absolutely new, for the pharmacentists on the Rhine used formerly to prepare their own bicarbonate of soda, and for this purpose they used carbonic anhydride prepared by fermentation of alcohol.

Professor MILLS said it would be very interesting to scrub the carbonic acid, from the different fermentation processes, through a scentless mineral oil, and examine the products as collected.

Mr. FAWSITT replied that he had not made this experiment. He did not claim novelty in the idea of using carbonic anhydride to prepare bicarbonate of soda; but it had never been done in this country as far as he knew.

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Improvements in Apparatus for Separating Substances of different Sizes or Specific Gravities. T. W. B. Mumford and R. Moodie, Victoria Docks. Eng. Pat. 1455, February 2, 1885. 8d.

THE apparatus, constructed according to this invention, consists of a casing, in which is enclosed a fan in proximity to a number of contracted passages formed by louvres, giving between them spaces inclined upwards towards the fan. When the fan is rotated, the currents of air so produced cause the separation of the finer from the coarser portions of matter fed into the apparatus. Series of receptacles or guides to receptacles are placed beneath the passages.—E. G. C.

Improvements in Centrifugal Machines for Drying Sugar and other Crystalline or Granular Substances. G. Fletcher, Litchurch; and W. P. Abell, Kirby Lodge. Eng. Pat. 1540, February 5, 1885. 8d.

IN centrifugal drying machines the inventors provide a

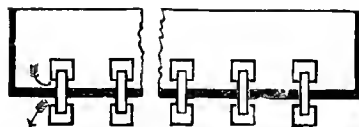
* Any of these specifications may be obtained by post, by remitting the cost price, plus postage, to Mr. H. Reader Laek, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8d.	4d.
Above 8d., and not exceeding 1s. 6d. ...	1d.
" 1s. 6d., " " " 2s. 4d. ...	1d.
" 2s. 4d., " " " 3s. 4d. ...	2d.

horizontal revolving disc, the upper surface of which is fitted with spiral arms reaching from near the centre to the periphery. These arms, which revolve in a direction coinciding with that of the spiral curve, are made of gauze, and have secondary solid spiral arms or shields behind them, forming channels or boxes, into which the liquid runs as it is driven through the gauze surface, and is thence, by means of suitable spouts, discharged into a circular trough. The solid material passes along the surface of the gauze arms until it is thrown off at the outer point, and is collected in the casing.—B.

Improvements in Apparatus for Distributing or Spreading Liquids over Surfaces. C. F. Claus, South Wimbledon. Eng. Pat. 585, January 15, 1885. 8d.

THE inventor distributes a liquid uniformly in small quantities over a large surface, by means of a number of small intermittent syphons or luted pipes, fixed in the bottom plate of a tank which is placed over and covers the whole surface to be moistened. The tank is fed inter-



mittently, preferably by means of either a large intermittent syphon, or of a tumbling box, supplying at each discharge a larger quantity of liquid than all the smaller syphons together can pass in the same interval of time. The sketch represents one of the arrangements of small sealed pipes.—B.

An Improved Pyrometer. J. Frew, Lanarkshire. Eng. Pat. 2568, February 25, 1885. 8d.

A BLAST of air, at approximately uniform temperature and pressure, is led by a tube through a small orifice in a tubular worm or other hollow vessel, placed within the hot blast pipe. The air is allowed to escape from the worm by an outlet orifice, constructed so as to be of smaller size than the inlet, a uniform pressure rather higher than the atmospheric pressure thus being maintained within the worm. The worm communicates with a vessel containing a coloured liquid, and provided with a vertical glass tube in which the liquid rises, in consequence of the expansion of the air within the worm, caused by the heat communicated by the hot blast. Uniform pressure of the cold blast passing to the worm may be obtained by the use of a pressure-reducing valve, or by dipping a branch from the cold blast inlet-pipe into water kept at an uniform level.—E. G. C.

Preventing the Formation of Scale in Boilers, Heaters, and other Apparatus, and removing Scale therefrom.

H. Aitken, Falkirk. Eng. Pat. 2662, February 27, 1885. 8d.

THE inventor places in the boiler series of zinc and copper plates, disposed in alternate layers. For the zinc he may substitute iron, and for the copper, carbon, silver or platinum.—B.

Improved Method of ascertaining the Specific Gravity, the Pressure, and the Component Parts of Fluids. Friedrich Lux, Ludwigshafen. Eng. Pat. 13,050, October 29, 1885. Sd.

A CLOSED weighing vessel is supported by one arm of the balance lever, and connected with conduits partaking of the oscillating motion of the beam. These conduits convey the fluid to be weighed into and out of the weighing vessel, the specific gravity, weight or pressure of the fluid being indicated continuously, so as to be read off a graduated scale connected with the balance.—E. G. C.

II.—FUEL, GAS, AND LIGHT.

Improvements in Apparatus for Generating Gas. Henry Hutchinson, London. Eng. Pat. 132, October 3, 1885. Sd.

THIS invention is an improvement upon that described in Eng. Pat. 2843, of 1883, according to which, gas is generated from carbonaceous matter in a retort by the action of the heat produced within the apparatus by the combustion of a portion of the carbonaceous material itself. An ordinary brick-lined generator is provided with a central structure, consisting of three concentric tubes. The innermost one, communicating at the top with the interior of the generator, and at the bottom with a gas main, is for carrying off the gases as they are evolved. The annular space between the innermost and the intermediate tubes is for the reception of liquid hydrocarbon, which is vaporised by the heat of the escaping gases, and passes by suitable openings into the body of the generator, mingling with and enriching the other gases evolved there. The outer tube is intended for heating the air used in the process, and also communicates by a number of openings with the interior of the furnace. This air is forced into the apparatus by a steam jet, and may, if desired, be mixed with hydrocarbon vapour. For further details of the plant, the original specification with its drawings must be consulted.—A. R. D.

Improvements in the Method of, and Apparatus for, Purifying Coal Gas. Jno. Hanson, Bingley. Eng. Pat. 1026, October 22, 1885. Sd.

THE gas is passed through a long casing of metal plates, inside which are two agitators working in opposite directions. These agitators are of cylindrical form, and packed with iron bars in such a way as to present an irregular kind of mesh for the passage of the gas. The iron casing is filled to a certain height with a mixture of ammoniacal liquor and oxide of iron; and the gas impinging upon this, as it adheres to the agitators, has the sulphur compounds eliminated. The liquor is revived by running the apparatus without passing gas through it.—A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Presence of 1:2:4:5 Durene in Coal Tar. K. E. Schulze. Ber. 18, 3032—3034.

THIS hydrocarbon was isolated from that portion of coal-tar boiling between 170° and 210°. After removing all basic and phenolic substances, the residual oil was subjected to fractional treatment with sulphuric acid of various degrees of concentration. The sulphonic acids thus obtained were then hydrolysed according to the method described by Armstrong and Miller (this Journal 3, 371). The first treatment of the oil was effected with dilute sulphuric acid containing 66 per cent. of H₂SO₄; the strength of the acid was gradually increased to from 75 to 95 per cent., and finally the oil was digested with fuming sulphuric acid containing from 5 to 50 per cent. of SO₃. On subjecting the last fraction to hydrolysis, a distillate was obtained, yielding a crystalline deposit on cooling. The latter was filtered off, pressed strongly,

and recrystallised from alcohol. Analysis gave numbers agreeing with the formula C₁₀H₁₄. The properties of this hydrocarbon are as follows:—White laminae exhibiting a faint fluorescence. Compared with naphthalene, its power of subliming is very slight. It has a faint odour similar to pseudocumene, melts at 80—81°, and boils at 196°. This hydrocarbon is therefore identical with the symmetrical durene obtained from xylene and pseudocumene by means of Fittig's synthesis.

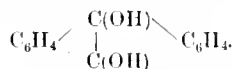
—D. B.

Anthrapinacone, a New Reduction Product of Anthraquinone. K. E. Schulze. Ber. 18, 3034—3036.

HAVING occasion to prepare chemically pure anthracene according to Perger's method, involving the reduction of anthraquinone to dihydroxyanthranol, and the decomposition of the latter into anthracene and water, the small yield (only 40 per cent. of the theoretical) induced the author to investigate the other compounds formed in the reaction. The organic matter was extracted from the zinc dust by repeated treatment with petroleum spirit as suggested by Perger. On treating the residual zinc dust with xylene, a further extract was obtained, which, on cooling, gave a crystalline deposit resembling dihydroxyanthranol in appearance, but differing from it by its greater insolubility in alcohol. The deposit was purified by recrystallisation from boiling benzene, toluene or xylene, white needles being obtained. On analysis, it gave numbers corresponding with the formula C₁₄H₁₂O. Hence it is a pinacone of anthracene. Anthrapinacone has a melting-point of 182°. When heated to 100° in a sealed tube with acetyl chloride dianthranyl (C₁₄H₈)₂ is formed. It crystallises in yellow laminae, melting at 300°.—D. B.

β-Hydroxyanthranol, a New Oxidation Product of Anthracene. K. E. Schulze. Ber. 18, 3036—3039.

CONSIDERATIONS on the constitution of anthraquinone and phthalylechloride made it desirable to investigate the progress of the oxidation of anthracene into anthraquinone. A series of oxidation experiments was instituted, the object being to find an oxidising agent which would admit of interrupting the oxidation before any anthraquinone is formed. Lead peroxide was found to give the best results, a compound being formed which resembled hydroxyanthranol in most of its properties, but differed in its behaviour with an alkaline solution of copper sulphate. The new substance separated cuprous oxide, and gave a black colour to the solution, whilst hydroxyanthranol merely decolourised the solution. Owing to the great instability of the compound, it could not be analysed by combustion. From the constitution of its ethyl derivative, prepared by boiling the substance with an alcoholic solution of potash and ethyl iodide, its formula appears to be C₁₄H₁₀O₂. Its constitution may be represented thus:—



The ethyl derivative forms yellow transparent rhombic crystals, the methyl compound crystallises in yellow transparent plates melting at 196°, whilst the benzyl derivative forms tough vitreous, almost colourless crystals, melting at 220°.—D. B.

On β-Picoline and the Synthesis of some Homologues of Pyridine. A. Heseckel. Ber. 18, 3091—3100.

THE author has prepared β-picoline, according to Zanon's method, from acetamide, glycerol and phosphoric anhydride. It boils at 141·5—143·5°, has a sp. gr. of 0·977 at 0°, and gives on analysis numbers corresponding to the formula C₈H₇N. The mercuriochloride forms fine white needles soluble in water and melting at 143°; the aurochloride is a yellow compound sparingly soluble in water, and melts at 182—184°; the picrate forms shining needles which are soluble in water and

alcohol, and melt at 145–146°. The zincchloride crystallises in white lustrous needles, sparingly soluble in water, and melting at 158°. The platinumchloride forms orange needles, melting at 214°.

The author has prepared *ethylmethylpyridine* $C_8H_{11}N$ from paraldehyde, acetamide, and phosphoric anhydride. It forms a clear colourless oil resembling collidine in odour, and boils at 175–179°. The platinumchloride, melting at 180°, forms rhombic orange plates; the aurichloride crystallises from water in yellow needles melting at 72°; and the picrate forms greenish yellow rhombic (?) plates melting at 175°.

Parvaline C_8H_9N was prepared by heating a mixture of propionic aldehyde, acetamide, and phosphoric anhydride to 190° for 48 hours. From the product of the reaction a colourless oil was isolated, which boiled at 196–200°. The platinumchloride crystallises in small needles, and the picrate in large yellow plates.—D. B.

IV.—COLOURING MATTERS AND DYES.

Improvements in the Production of Azo-colours on Textile Fibre. Thomas Holliday. Eng. Pat. 2580, February 25, 1885. 6d.

THE object of this invention is to produce in the fibre mixed azo-compounds derived from monamines, such as aniline and its homologues, the naphthylamines, amido-azo-benzene, etc., and the azo-derivatives of the rosaniline colouring matters. As an example of the mode of application, the inventor gives the following:—Naphthylamine and rosaniline are dissolved together by means of dilute hydrochloric acid, and diazotised in the usual way. The fabric is first immersed in a solution of naphthol after which the excess of liquor is wrung out, and then it is transferred to the solution of the mixed diazo-chlorides, when the colour is at once developed. Other modes of application are described in the patent.—R. M.

A Manufacture of Blue and Violet Colouring Matters. Herbert John Haddan, 67, Strand. From the "Farbenfabriken vorm. F. Bayer & Co.," Elberfeld. Eng. Pat. 3449, March 10, 1885. 6d.

THE colouring matters in question are produced by the action of Rathke's "perchloromethyl-mercaptan" (resulting from the action of Cl upon CS_2) upon tertiary monamines. The process is illustrated by the manufacture of a colouring matter from dimethylaniline, twenty-five parts of this base being mixed with eight parts of calcium carbonate in a vessel provided with a stirrer, eleven parts of the mercaptan being run into the cold mixture. The temperature is then raised to 80° C. by means of a water-bath, and kept thus for twenty-four hours, when a coppery melt is obtained, from which the crystallisable colouring matter can be extracted by means of water after the removal of the excess of dimethylaniline by steam distillation. The colour-base is converted into one of its salts for the market.—R. M.

Colouring Matters obtainable by the Combination of Tetrazoditolyl or Tetrazodicycyl Salts with Alpha- and Beta-naphthylamine or their Mono- and Disulphonic Acids, and Process for the Manufacture of the same. Herbert John Haddan, 67, Strand. From the "Farbenfabriken vorm. F. Bayer & Co.," Elberfeld. Eng. Pat. 3803, March 14, 1885. 4d.

THE diamidoditolyl and diamidodicycyl required are prepared from nitrotoluenes and nitroxylenes according to the method of G. Schultz (*Ber.* xvii, 467 and 472), and these are diazotised in the usual way. The tetrazo-salts are made to act upon solutions of the salts of the naphthylamines either in aqueous or alcoholic solutions, and the resulting insoluble azo-colours converted into sulphonic acids. If the sulphonic acids of the naphthylamines are employed, alkaline solutions of their salts must be made use of, and the resulting azo-colours are soluble. Particularly fine colouring matters are said to be obtained by the action of the tetrazo-chlorides upon

the β -naphthylaminesulphonic acid obtained by the action of NH_3 upon Schäffer's β -naphthol-monosulphonic acid and upon the β -naphthylaminesulphonic acid, formed by heating β -naphthylamine with strong H_2SO_4 to 200–210° C. These tetrazo colours are said to be much more soluble, and to be less sensitive to acids than the corresponding benzidine colours; they have the property of dyeing unmoordanted cotton in an alkaline bath.

—R. M.

Improvements in the Manufacture of Azo Dyestuffs or Colouring Matters. Emil Elsaesser, Brogler Strasse, Barmen, Prussia. Eng. Pat. 14,232, November 20, 1885. 4d.

THE colouring matters forming the subject of this patent are produced by the action of the diazo-salts of Merz and Weith's thioparatoluidine (*Ber.* vol. iv, p. 393) upon the sulphonic acids of the naphthols and naphthylamines. In order to prepare thioparatoluidine, eleven kilos. of sulphur are dissolved in forty kilos. melted paratoluidine, heated to 150° C. in an iron vessel, and forty-two kilos. of litharge are gradually added till the further addition of this substance no longer produces an effervescence. The excess of toluidine is removed by steam distillation, and the thio-base extracted by means of dilute hydrochloric acid, and precipitated by means of an alkali. By acting upon the hydrochloride of the thio-base with nitrous acid, tetrazothioparatoluidene-chloride is produced, and this can be combined with the naphtholsulphonic acids, etc., in the usual manner. As an example, the inventor gives the process for making the red dyestuffs resulting from the action of the tetrazo-salt upon the theoretical quantity (two molecules) of β -naphtholdisulphonic acid, or of Piria's naphthionic acid.—R. M.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

Improvements in Means for Rendering Fabrics and other Substances Uninflamable, Obnoxious to Vermin, Resistant to Putrefaction, to the Reception of Morbid or Diseased Matter, and to the Growth of Spores, Fungi, Bacteria, and the like. W. L. Wise. From Josef Ferdinand Notz. Eng. Pat. 1232, January 28, 1885. 6d.

THE inventor claims for the above purposes the use of a liquid containing sulphate of ammonia, carbonate of ammonia, borax, bichloride of mercury, peppermint, carbolic acid, bi-tungstate of soda, and chloride of lime, transformed into an emulsion by leading into the solution the products obtained from the distillation of a solution of Peruvian balsam and camphor.—E. J. B.

An Improved Means and Method of Making Woven and Felted Fabrics, Cardboard, and Wood Waterproof and Acid Proof. H. Sharp. Eng. Pat. 2534, February 25, 1885. 6d.

THE material to be rendered waterproof is thoroughly dried by being heated in vacuo, and whilst still hot is saturated with melted paraffin wax containing a small proportion of liquid paraffin. When cold it is passed between hot rollers so as to spread the wax more evenly, and is finally passed through cold calender rollers, to which a heavy pressure is applied. For certain purposes the fabric may be previously prepared by soaking in a solution of gelatine, containing one-fifth of its weight of bichromate of potash.—E. J. B.

Improvements in the Method of, and Machinery for, Washing or Scouring Wool. W. Cook. Eng. Pat. 4028, 1885. 8d.

THE wool is carried forward on an endless belt of wire gauze through a series of troughs, in which water is caused to flow at the same speed by means of paddles. In its passage through the troughs, the wool is occasionally squeezed by perforated drums. Complete drawings accompany the specification.—E. J. B.

A New or Improved Apparatus for Washing Wool by a Continuous Stream of Water, and also for Purifying such Water. A. Deletombe and A. Prouvest. Eng. Pat. 4586, 1885. 11d.

By this method the wool passes through a series of tanks placed at different heights. After undergoing a certain amount of cleansing in the top tank, it is raised by means of paddles, and transferred to the next lowest tank. In passing from one tank to another, the wool is squeezed by means of rollers. The proper amount of soap solution is supplied regularly by means of a patent apparatus (Mehil's patent). The dirty water from the tank is filtered through a cloth bag, and is transferred to a large vessel, where it is decomposed by an acid, and the fatty matters recovered. The water then undergoes a further process of settling and filtration; it may then be used for washing out the tanks. The inventor claims a considerable economy of soap by the use of the apparatus. —E. J. B.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

On the Fixation of Aniline Dyes with Antimony Compounds. Chem. Zeit. 1710, 1885.

LAUBER and Schweikert made a large number of experiments in order to investigate the action of tartar emetic and antimony oxalate in the fixation of aniline dye tannates on the fibre. The authors came to the following conclusions:—(1) There is no material difference between equal weights of tartar emetic and antimony oxalate as regards the fixation of aniline dye tannates, although the oxalate contains less antimony. The use of the latter is therefore recommended on account of the considerable saving in money. (2) Mixtures of chalk and antimony salts act better than antimony solutions alone. (3) Basic antimony compounds, or antimony hydrate respectively, have no action in fixing aniline dyes.—S. H.

Improvement in the Preparation of the Sensitive Paper or other Fabrics applicable as a Substitute for Glass in Photography. L. Warnerke. Eng. Pat. 2699, 2d.

IN this invention, paper or other transparent or semi-transparent tissue is rendered sensitive to light on both sides. The light passes through the paper, which on development gives an image on both sides. Greater brilliancy and softness are produced in the prints from the negative obtained with such a paper.—E. J. B.

Improvements in the Means or Apparatus employed for Dyeing Woollen, Silk, and other Woven or Felted Fabrics and Yarns. Joseph Rellitt. Eng. Pat. 6295, May 22, 1885. 6d.

THE material to be dyed is passed through a small trough containing the dye, and is then passed over cylinders heated by steam. In this way considerable amounts, both of fuel and colouring matter, are saved. —E. J. B.

VII.—ACIDS, ALKALIS, AND SALTS.

On Pyrites. William Martyn. Abstract from "Mineral Resources of the United States, calendar years 1883 and 1884."—Department of the Interior, United States Geological Survey.

OCCURRENCE IN THE UNITED STATES.

New Hampshire.—From this State comes an excellent ore admirably adapted for acid making, and comparing favourably with the best Spanish ores. It is mined at Milan, in Coos county. The vein is 15 to 25 feet wide. There are also large quantities of ore containing a fair percentage of copper and silver, which are smelted at the mine, the copper matte being shipped to New York to be refined. The composition of Milan ore No. 1 is about

as follows:—Sulphur, 48.0 per cent.; iron, 43.0; copper, 1.6; zinc, 1.5; silica, 5.0; arsenic, traces; total, 99.1 per cent. The ore burns readily without clinkering, and requires very little attention to insure thorough desulphurisation. Milan ore No. 2 contains less sulphur and more zinc (up to 11 per cent.) than the above, which latter metal prevents the recovery of a fair proportion of sulphur owing to the formation of zinc sulphate. The mine is owned by the Milan Mining Co., of Boston, which supplies the ore broken to size, and screened ready for charging into the kiln.

Vermont.—At the Ely mine large quantities of low grade pyrites are found, but owing to its low percentage of sulphur, it has thus far not been used for acid making.

Massachusetts.—In the town of Rowe, Franklin County, is the Davis mine, at which work was commenced in 1882. The vein material is almost pure iron pyrites with a slight admixture of copper pyrites and quartz. The ore, which is distinctly crystalline, has the following composition:—Sulphur, 48.0 per cent.; iron, 44.0; copper, 1.6; zinc, lead, etc., 1.5; silica, 3.7; arsenic 0.2; total, 98.8 per cent. The "smalls" are remarkably pure, containing upwards of 48 per cent. of sulphur, and can be readily roasted down in shelf burners to 3 per cent. sulphur. A large quantity of Davis ore has been burned during the last few years, and it is in favour with manufacturers owing to the absence of arsenic. This, while of no great moment so far as the application of the greater portion of the acid is concerned, may yet be an important matter as regards the wear and tear of the chamber lead.

New York.—There are mines in Saint Lawrence County, near De Kalb. The ore contains 38 to 40 per cent. sulphur, and 2.75 per cent. copper. Some of it is said to contain a considerable percentage of silver. The ore is shipped to Canada and to Detroit.

Virginia.—The rich Virginian ore has a good place in the market. The following analysis of it is by Dr. Völkner, of London:—Sulphur, 48.02 per cent.; iron, 42.01; peroxide of iron, 1.93; sulphuric acid, 0.44; silica, 7.60; copper, none; arsenic, none; total, 100.00. Other analyses show from 46 to 50 per cent. sulphur. Lately the percentage of copper has increased, and in this way the value of the ore has risen. Three mines have been worked in Louisa county belonging to the Arminius Copper Mines Co., the Sulphur Mines Co. of Virginia, and Messrs. Charles Lenning and Boyd Smith respectively.

Georgia.—The pyrites raised at two mines in this State have been used for acid making. The mine of the Tallapoosa Copper Production Co. is in Haralson County, and that of the Paulding County Mining Co. is in Paulding County. Some of the ore contains as much as 11 per cent. copper, but the average is very much lower. The ore tests about:—Sulphur, 40.00; copper, 2.75; and silica, 8.00 per cent.

Deposits not now Worked.—There is scarcely a State in the Union in which pyrites does not occur to a considerable extent, and at the present time sulphuric acid makers can be cheaply supplied from the mines already opened. Many more of the existing deposits not now worked will doubtless be drawn upon as new acid making centres spring up.

FOREIGN DEPOSITS.

Canada.—The ore from Canadian deposits was the first to be used in the United States for making oil of vitriol. The Canadian pyrites are now supplied by the Albert mine, belonging to Messrs. G. H. Nichols & Co., of New York, and the Crown Mine, owned by the Orford Copper and Sulphur Co. The ore is very compact, and forms very little "smalls" on breaking. It burns well in the kilns, in which the charge may be 25 per cent. larger than with Spanish 48 per cent. ore. Its composition is about as follows:—Sulphur, 40.0; iron, 35.0; copper, 4.0; silica, 20.0 per cent.; arsenic, traces; and silver, 40zs. per ton. The cinders which were formerly smelted are now treated by the wet process for both copper and silver. Details on the deposits of pyrites in Spain, Portugal, France, and Germany are then stated, which

have been published so very frequently as to need no further mention in this abstract.

Domestic Production.—The production of pyrites in the United States during the last three years is given approximately below:—

Years.	Tons of 2,240 lb.	Spot Value.
1882	12,000	72,000 dollars.
1883	25,000	137,000 ..
1884	35,000	175,000 ..

The amount of capital in pyrites mining is probably about 200,000 dollars, and the number of men employed in 1884 was 175.

in many cases. Indeed, at the present time, none of the three great Spanish pyrites companies show any inclination to cultivate the American trade. A reduced consumption of pyrites in Europe by the introduction of any sulphur recovery or the ammonia-soda process, will probably result in the Spanish companies endeavouring to compensate themselves for the loss of European business by shipping at first large quantities of non-euphriferous ore to the United States. When the volume of business there becomes large enough, they will probably make extensive arrangements for treating the cinders and begin to ship euphriferous ore there, unless indeed they can make more profit by treating the ore for copper

IMPORTS OF PYRITES INTO THE UNITED STATES FROM 1880 TO 1881 INCLUSIVE.

Fiscal Years ending June 30.	CANADIAN.				NEWFOUND- LAND.		SPANISH.	TOTAL.
	Tons.	Copper.*		Value. dollars.	Duty. dollars.	Tons.	Tons.	Tons.
		per cent	lbs.					
1880	1,958	—	1,125,296	156,834	33,758	—	—	—
1881	10,812	4.0	982,809	102,543	29,786	—	1,115	11,927
1882	23,980	3.0	1,591,811	160,473	47,754	—	5,838	29,818
1883	25,211	2.5	1,403,900	131,400	39,879	—	10,600 †	35,811
1884 ‡	26,000	3.7	2,151,800	—	—	2,600	16,250	41,250

* The figures represent "dry assays"—1.30 per cent. less than actual (wet) assays. The Spanish ore imported has contained an average of only 1.25 per cent. copper (wet assay). Newfoundland ore contained about 3 per cent. wet assay.

† Spanish pyrites includes 1473 tons Portuguese (Mason and Barry) in 1883. The balance is almost all Rio Tinto ore.

‡ All the figures for 1884 are estimated, as also is the quantity of Spanish ore for 1883. This has been rendered necessary by the practice of some of the custom houses not to keep pyrites separate from iron ores.

Works burning Pyrites.—There are at present 23 establishments in the United States burning pyrites. They are located as follows:—Boston and eastern district, 5; New York district, 9; Philadelphia district, 2; Baltimore district (including South Carolina and Georgia) 3; western district, 4; total, 23. Two of the works use Canadian ore, four Spanish ore only, two Spanish and domestic, and fifteen domestic ore only. Nine of these establishments use grate burners only, nine grate and shelf burners, two shelf burners only, and three use the Spence mechanical furnace. The acid made at ten of the works is used for fertilisers, at three for oil refining, and at ten for miscellaneous purposes.

Terms on which the Ore is purchased.—The ore is usually bought under guarantee that it shall contain not less than an agreed percentage of sulphur, and that there shall not be more than a certain proportion of "smalls," say 7.5 per cent., through a $\frac{1}{4}$ inch mesh screen. Sometimes it is stipulated that the amount of zinc shall not exceed, say 2 per cent. The cinders are either given to the buyer, or are removed at the expense of the seller. After stating the manner of sampling and testing the ore for sulphur, some statistics on the pyrites consumption in the United States, England, France, Germany and Belgium are given, whence it must be concluded that the total quantity of pyrites used throughout the world for oil of vitriol making cannot be less than one million tons per year. The different kilns and burners for roasting lump ore and "smalls" are then described, as well as the Henderson wet copper process in combination with Claudet's silver process.

Competition of Foreign and Domestic Ores.—Although the Spanish pyrites practically control the whole pyrites trade of the Old World, it is probable that the domestic ore will be able for the present to hold its own side by side with Spanish ore in the American market. On the whole, the mines are near to manufacturing centres, the percentage of sulphur in the ore is high, copper and silver are present in suitable quantity, and it is comparatively free from zinc, lead, lime, etc.; whereas the absence of arsenic makes it preferable to Spanish ore

at the mines in Spain. This last supposition seems extremely unlikely. The cost of treating a 3 per cent. ore for copper at the mines is probably in no case less than 2 dollars per ton. If the same ore were shipped to the United States, the debits and credits would stand about as follow:—

DEBITS.	
Freight to Huelva	0.50 dollars.
Duty 75 cents per ton, plus 10 per cent. of 25 per cent. per lb. on 1 per cent. copper	0.80 ..
Ocean freight, etc.	2.75 ..
Treatment of cinder	4.90 ..
Balance in favour of shipping to the United States	1.65 ..
	10.60
CREDITS.	
Sulphur (say)	5.75 dollars.
Purple ore (3 dollars per ton)	2.10 ..
Silver	0.75 ..
	8.60 ..
Add cost of treatment at mine	2.00 ..
	10.60 ..

Time will show whether these apprehensions of extensive foreign competition with domestic ores are warranted or not.

Comparison of Pyrites and Brimstone.—In conclusion, there is a comparison between the cost of acid made from pyrites and brimstone. In such a calculation it must be kept in view that the cost of burners for pyrites is twice as much as for brimstone. On a ton of pyrites acid of 50° B. (106° Tw.) there is a charge of 35 cents for labour, whereas on a ton of brimstone acid of equal strength the cost for labour is only 27 cents. The wear and tear of chambers is between 20 and 30 per cent. greater with pyrites than with brimstone. On the other hand, the selling price of brimstone at the close of 1884 was about 23 dollars per ton, whereas the same available amount of sulphur in pyrites costs very considerably less, and there can therefore be no doubt that acid can be made from pyrites much cheaper than from brimstone.—S. H.

Material for "Packing" Glover Towers. Chem. Zeit. 1695, 1885.

THE "Rheinische Industrie für feuerfeste Produkte, Bendorf-am-Rhein," now makes clay tubes 12cm. or 15cm. long by 10cm. diameter, which are used in the place of flint for Glover towers. In this manner a far greater available surface is obtained, and owing to the small weight of these tubes, the structure need not be so strong.—S. H.

Manufacture of Zinc Chloride. Chem. Zeit. 1905, 1885.

SCRAP zinc placed in a stone, cast-iron, or wooden vessel, is dissolved in hydrochloric acid. The solution is neutralised with sodium carbonate warmed from 40° to 50° C., and a little bleaching powder added to precipitate iron and manganese. The clear zinc chloride solution is siphoned off and boiled down in enamelled iron pots. The evaporation is continued until the liquor shows a heat of 230 to 240° C., a little potassium chlorate is added to oxidise any organic matter, and some pure hydrochloric acid carefully poured into the hot solution in order to dissolve any basic salt. The mass is then allowed to solidify, the agitation being kept up all the time, and while still warm packed in iron drums of 30kgms. to 50kgms. capacity, which are at once closed air-tight.—S. H.

Improvements in the Treatment of Sulphides in Alkaline Solutions by Electrolysis. H. W. Deacon, F. Hurter, Widnes, and W. Elmore, Surrey. Eng. Pat. 800, January 20, 1885.

A CURRENT of electricity is passed through solutions containing alkaline sulphides, so that the sulphides contained in the said solutions may be decomposed by the current in such a manner that the sulphur is deposited upon the anode, hydrogen being evolved at the cathode; or that a portion or practically all of the sulphur is oxidised at the anode, hydrogen being evolved at the cathode. The alkali metal of the alkaline sulphide is thus obtained, either in form of caustic alkali, or as an alkaline sulphate. A convenient mode of removing the sulphur from the anode is effected by causing the anode to travel continually by mechanical means into and through the solution, and afterwards to pass by a scrubber or brush, which removes the sulphur and discharges it into a suitable receptacle.

Improvements in the Manufacture of Sulphur from Sulphuretted Hydrogen and Sulphurous Acid, or a Salt thereof. J. W. Kynaston, Liverpool. Eng. Pat. 2473, February 24, 1885. 6d.

IT is proposed to carry out the mutual reaction of sulphuretted hydrogen on sulphur dioxide in a new manner. Calcium or magnesium sulphite suspended in water is pumped into a flagstone still, provided with a wooden agitator. The latter is caused slowly to revolve, and then a current of sulphuretted hydrogen is forced in through a leaden pipe reaching to the bottom of the still. After a few minutes, or as soon as the mixture in the still is saturated with the gas, dilute hydrochloric acid (8 to 10° Tw.) is run in, and so regulated that for every two equivalents of sulphuretted hydrogen passing in, two equivalents of hydrochloric acid are added. The decomposition takes place according to the equation:— $\text{CaSO}_3 + 2\text{HCl} + 2\text{H}_2\text{S} = \text{CaCl}_2 + 3\text{S} + 3\text{H}_2\text{O}$. The batch is then run off to a filter bed, where the sulphur, which is in a pulverulent condition, is retained. The hydrochloric acid used must be perfectly cold, the success of the process depending greatly upon the temperature being kept as low as possible throughout. It is contended that by this mode of proceeding the formation of thionic acids and a consequent loss of sulphur can be completely avoided.

—S. H.

Improvements in Decomposing Liquors containing Chloride of Magnesium. J. Wilson, Berwick-on-Tweed. Eng. Pat. 3098, March 10, 1885. 6d.

THE liquor to be decomposed is evaporated till the liquid has a temperature of 300° F., or until a sample on cooling solidifies well. This concentrated solution is then run in a constant stream into a furnace, where it is mixed with a suitable absorbing agent; and the resulting solid mass is heated until it is sufficiently decomposed. It is proposed to use as absorbing agent the product of the decomposition of the concentrated liquor of a former operation. These steps are taken with a view of preventing the fusion of the mass, and the consequent destruction of the furnace bed.—S. H.

Improvements in the Manufacture of Potassium Sulphites. A. Boake and F. Roberts, London. Eng. Pat. 5882, May 13, 1885. 4d.

THIS invention consists in the manufacture of a new bisulphite of potassium, to which the name of isohydro-bisulphite of potassium has been given. Potassium bicarbonate or a mixture of potassium sulphate and calcium hydrate are treated at a boiling temperature with sulphurous acid, until the whole base is converted into bisulphite. The solution is allowed to crystallise, the mother-liquor being again treated with more base and sulphurous acid.—S. H.

Improvements in the Production of Sulphurous Acid for the Manufacture of the Sulphites and Bisulphites of the Alkalis and Alkaline Earths. P. Hart, Manchester. Eng. Pat. 13,950, November 16, 1885. 4d.

SULPHUR dioxide in a practically pure state is obtained by acting with strong sulphuric acid upon any of the sulphides, such as the sulphides of iron, copper, lead, tin, antimony, zinc, arsenic, etc. In practice, finely ground iron pyrites are placed in a cast-iron retort, and mixed with sulphuric acid of 1·750 sp. gr. Heat is then applied, and when the temperature has reached 400° F., a steady stream of nearly pure sulphur dioxide gas is evolved, which after passing a cooling arrangement can be used for the manufacture of sulphites or bisulphites.

—S. H.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

An Improved Method of Preparing Glass for forming Coloured Designs thereon, and in the Means of Producing such Coloured Designs thereon. G. K. Cooke, London. Eng. Pat. 1431, February 2, 1885. 6d.

THE inventor flashes by fusion on one or both sides of flat glass one or more thin films of coloured glass. A "resist" of asphaltum-wax, or other material, is employed to form the design, either by itself or by leaving exposed in design on the glass. Suitable corrosive agents are used on either side, and on both sides when producing contrasts or combinations of colours.—T.

Process for Producing on Metal Plates a Layer of Material as a Substitute for Lithographic Stones. H. J. Haddan, London. From Julius Wezel, Saxony. Eng. Pat. 3305, March 13, 1885. 4d.

LITHOGRAPHIC stone, chalk, marble, lime, etc., are dissolved by means of sulphuric and hydrochloric acids, and from this solution "chalk combined with resinous or fatty acid" is precipitated by means of resin, or good soft soap. After the superfluous acid has been removed by filtration, the residuum is dried to a powder, which forms a mixture of lime in combination with fatty or resinous acid and sulphate of lime. The dry powder is distributed mechanically in a weak solution of soda, and blown on to the hot metal plate by a steam injector, or other suitable contrivance.—E. G. C.

Improvements in the Manufacture of Glass Articles Decorated with Stripes. W. Boulton, Andnan, Kingswinford. Eng. Pat. 8585, July 15, 1885. 6d.

THE inventor purposes to apply two or more stripes by a single act to the article to be decorated, or divide a single mass of decorating metal into two or more smaller masses, each of which may be used for the production of a decorated article. He details the manipulation by which the result is effected.—T.

Improvements in and relating to Glass Furnaces. From T. W. Synnott, of Wenoah, New Jersey, U.S.A. Eng. Pat. 13,685, November 10, 1885. 8d.

THIS invention is applied to the combination with a glass furnace of a tank for holding batch, or glass-making material, so that the operation of the furnace may be carried on continuously. There are numerous drawings illustrative of the construction and distribution of air and steam-flues—the glass holding tank-belt, the batch holding tank, and other parts. There are seventeen claims in the patent.—T.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

New and Improved Building Material. E. Robbins, London. Eng. Pat. 12,803, September 25, 1884. 6d.

THIS invention consists of special methods to be employed in preparing, forming and finishing concrete materials for building and other purposes. Unground plaster is submitted to various processes, such as boiling, firing, pressure, induration by immersion in various liquids, treatment with tar, pitch, alkaline silicates, acids, dyes, sulphur vapour, etc.—E. G. C.

Non-conducting Compositions or Coatings. E. C. C. Stanford, Dumbarton. Eng. Pat. 13,312, October 8, 1884. 4d.

IMPROVEMENT on Eng. Pat. 2132, 1882. Inventor uses silicate of potash, soda or ammonia, in conjunction with wood-, peat-, seaweed-, or other form of charcoal, to which mixture he prefers to add a little lime, magnesia, alumina, or silica, in powder. With such addition the composition sets like cement.—E. G. C.

Improvements in the Manufacture of Portland Cement. H. J. Cooper, Wexford. Eng. Pat. 14,010, October 22, 1884. 4d.

THE inventor effects economy in fuel by utilising the heat of iron slag as it issues from the furnace in a molten state, and he adds to the slag, while in this condition, chalk, limestone or lime, afterwards thoroughly mixing the materials by passing the mass through rollers, mortar mills, or other suitable apparatus. If necessary, the operation may be continued by heating the mass in a furnace, heated by coal, coke or gas. It is completed by cooling and granulation, followed by pulverisation.—E. G. C.

Machinery for the Production of Concrete and Mortar. A. E. Carey and E. Latham, Newhaven and Liverpool. Eng. Pat. 14,115, October 25, 1884. 6d.

THE inventors refer to a previous patent, No. 1812, 1881, and under their present invention they effect the production of concrete and mortar by a single and gradual mixing of the required materials, instead of employing double mixing, as set forth for concrete in the above-mentioned patent.—E. G. C.

Furnaces for Burning Cement and other Substances. P. M. Justice, London. Communicated by C. Dietzsch, Germany. Eng. Pat. 14,324, October 29, 1884. 6d.

THE improved furnaces contain a cooling space, a burning space, a pre-heating space, and a connecting passage

between the pre-heating and burning spaces. The oblong form is better than the circular. The lining is formed of bricks, made by highly burning "marlstone of the dolomite formation," so that it forms a silicate soluble in hydrochloric acid, by mixing this silicate with burnt dolomite, moistening the material with water, and pressing it into the required form. The bricks so produced harden by exposure to the air, and may then either be used for lining the furnace, or first burnt.—E. G. C.

Imitation Marble. A. Bruce Joy and J. J. Lewen, London. Eng. Pat. 14,430, October 31, 1884. 2d.

CASTS of statues, etc., are made of plaster of Paris, mixed with zinc white (15–20 parts of the former to one of the latter), finely flaked mica being sometimes added. When quite dry, the casts are immersed in refined linseed oil, for six or seven days; they are then removed and allowed to stand in a warm place for four or five days. A mixture of old refined linseed oil and flake white is now applied to the surface, which is thus caused to present the appearance of old marble.—E. G. C.

Improved Artificial Stone. J. Thompson and J. H. Bryant. Eng. Pat. 15,014, November 14, 1884. 4d.

THIS artificial stone is manufactured from Portland cement, granite chippings, iron slag and silicate of soda, together with the requisite quantity of water. The proportions of the ingredients preferred by the inventors are—

Portland cement	15 parts by measure.
Crushed granite	15 " "
Crushed iron slag	40 " "
Silicate of soda	10 " "
Water	20 " "

100

—E. G. C.

Improvements in the Utilisation of a Waste Product. J. T. Welch, Carnarvon. Eng. Pat. 15,275, November 20, 1884. 4d.

THE debris of slate quarries is ground up and submitted to hydraulic pressure, to make it into blocks. These blocks, if dipped in potters' slip and burnt, furnish excellent bricks and tiles.—E. G. C.

Process for rendering Cements Hydraulic. W. P. Thompson, London. From R. Rosse and F. Wolters, Brunswick. Eng. Pat. 8153, July 6, 1885. 2d.

COMPOUND cements are rendered hydraulic—while, at the same time, their homogeneity and strength are increased—by a supplementary grinding in ball-mills or similar machines, which, by compression, bring closer together the smallest particles, and give them a lamellar structure.—E. G. C.

Machinery for Finely Dividing and Tempering Clay. W. P. Thompson, Liverpool and London. From Clayton Potts and A. Potts, Indiana, U.S.A. Eng. Pat. 8554, July 15, 1885. 6d.

CLAY is automatically pressed against a revolving cylinder, which removes successive portions from the mass, and so effects its disintegration.—E. G. C.

Improvements in Plastic Compounds. H. W. Merritt, Mass., U.S.A. Eng. Pat. 8736, July 20, 1885. 6d.

"ASBESTINE," a natural mineral deposit, consisting of silica 61.23 per cent., magnesia 31.37 per cent., alumina 1.99 per cent., ferrous oxide 0.37 per cent., and water 5.02 per cent., is ground to powder and mixed with quartz-sand and caustic soda or potash dissolved in water. The result is a plastic mass, "which can be worked and applied like mortar, and which, when spread and exposed to the air, turns as hard as a stone, without tendency to crack or crumble." When the plaster is

intended to be applied to smooth surfaces, as masonry or glass, etc., a small proportion of silicate of soda may be advantageously introduced.—E. G. C.

Preserving Stone. A. W. L. Reddie, London. From T. Eggleston, New York. Eng. Pat. 9087, July 28, 1885. 2d.

THE surface of the stone is saturated, according to the requirement of the particular case, with "fat-oil," with petroleum products dissolved in fat-oil, or with a compound of fat-oil, petroleum products, and sulphur.

—E. G. C.

Improvements in Method of and Apparatus for Vulcanising Rubber. F. W. Seabury, Providence, U.S.A. Eng. Pat. 10,058, August 25, 1885. 6d.

ACCORDING to this invention, the rubber is subjected to the action of superheated steam within a receptacle heated externally by an auxiliary furnace. All possibility of condensation of steam upon the rubber is in this manner avoided, and the utmost uniformity in the product is attained.—E. G. C.

Improvements in the Manufacture of Cement or Mortar. W. Keller, Aix-la-Chapelle. Eng. Pat. 13,639, Nov. 10, 1885. 4d.

THE cement or mortar manufactured according to this invention is composed of gypsum, cement, or any other binding agent, intimately mixed with pieces or fibres of metal, such, for example, as wire, or other metallic bodies imparting a fibrous nature to the product. The hardness of the product and its power of resisting tensile strain are said to be greatly increased.—E. G. C.

X.—METALLURGY, Etc.

The Extraction of Zinc from Burnt Pyrites. T. Meyer. Chem. Zeit. 1885, 1904.

OWING to the large percentage of zinc which is found in the Siegen pyrites, the burnt ore cannot be used in the blast furnace, and thus forms a troublesome by-product of the vitriol works. It is therefore very important to remove the zinc from the burnt ore and to convert it into a valuable product, and the author reports on some experiments made by him with that view, which, although they gave a negative result, may be of interest to others. The pyrites contained 40.47 per cent. sulphur and 8.92 per cent. zinc, whereas the burnt ore tested 8.05 per cent. sulphur and 12.54 per cent. zinc. After powdering and igniting it once more, it only contained 1.95 per cent. sulphur, which residue is probably present in the form of sulphates. The zinc must now be in the state of oxide. It was tried to extract the zinc oxide with a solution of ammonium sesquicarbonate, but although the digestion was kept up for eight hours, agitating all the while, only 30.6 per cent. of the zinc and 29.2 per cent. of the sulphur present in the burnt ore could be dissolved. This reaction can therefore not be made use of on the large scale, but it is worth mentioning that an analogous method for the extraction of zinc oxide, which is formed by the oxidation of zinc by steam, works very satisfactorily in the desilvering process of lead by means of zinc.—S. H.

The Application of Thomas-Slag as Artificial Manure. Chem. Zeit. 1886, 52, 83, and 103.

THE opponents of the application of Thomas-slag as an artificial manure, hold that by far the greater part of the phosphoric acid in the slag is combined with iron, and therefore not worth as much as calcium phosphate. L. Blum argues that this view contradicts the theory of the Thomas-process. At the commencement of the operation silicon and manganese combine with a small portion of iron, and afterwards the combustion of carbon and phosphorus takes place. Owing to the high temperature, the lime now acts on the metal slags formed,

liberating the oxides of the metals and combining with phosphoric and silicic acids. Lime, as the stronger base, deprives the salts of a less strong base of their acid, and the phosphates and silicates of iron and manganese are converted into the corresponding lime salts. This is also borne out in practice by the fact that if lime be deficient during the process, the dephosphorisation is incomplete. The slag running off at the end of the operation therefore contains the phosphoric acid chiefly as calcium phosphate. Maltzan, without taking any notice of Blum's paper, maintains that the phosphoric acid in Thomas-slag is combined with iron, and he dwells on the difficulty of dissolving iron phosphate, especially if this has been previously ignited. He characterises the slag as a phosphate of the least possible solubility. Furthermore, certain impurities of the slag, such as metallic iron (four per cent.), ferrous oxide (eighteen per cent.), calcium and iron sulphide (three per cent.), are injurious to the life of young plants. Another disadvantage is the presence of a high percentage of caustic lime (as much as twenty-five per cent.), which makes the application of ammonia salts quite impossible. Wherever the use of Thomas-slag proved successful, the application of lime would have had the same result, and slag costs eight times as much as lime. A great many patents have been taken out for the elimination of iron and caustic lime from the slag. The only rational method of working is to prepare dibasic calcium phosphate, as in Scheibler's patents, but this can only be done at an expense for hydrochloric acid, which makes the process unremunerative. Lately, however, the hydrochloric acid has been replaced by sulphur dioxide, which, mixed with air (waste gases from zinc or copper works, etc.), readily attacks the powdered slag, converting the caustic lime into gypsum and oxidising the metallic iron, as well as ferrous and manganous oxides and sulphides. By this treatment the consumption of hydrochloric acid is reduced to a third (owing to the insolubility of gypsum), and since all the iron compounds are converted into iron oxides, which are only slightly soluble in dilute hydrochloric acid, the extraction with this acid produces a solution of phosphoric acid, nearly free from iron. This solution may then be employed for the manufacture of precipitated phosphates.—S. H.

Improvements in the Manufacture of Iron and Steel. George Rowell, M.D., South Kensington, S.W. Eng. Pat. 1866, February 10, 1885. 8d.

A PART of the reduced iron is to be forced upwards from the crucible of the furnace through tubes situated in the walls, and to be blown in as a spray at the tuyères with the blast, with the object of reducing any ore which has escaped reduction. The metal is cast in ingots under pressure by means of a special apparatus described in the specification.—W. G. M.

Improvements in Separating Metals from their Ores, Refining Metals, Making Alloys of Metals, and Analogous Operations. Leon Quentin and Arthur Brin, Paris. Eng. Pat. 2025, February 13, 1885. 8d.

THE ore or metals to be reduced, refined, or alloyed, are placed, in a finely-divided condition and mixed with powdered coal, in a crucible which should be as free as possible from silica. Into the middle of the mass an earthenware pipe is introduced. The whole is heated to a "cherry red" in a suitable furnace, and then to a far higher temperature. Oxygen is then blown through the central tube, causing rapid oxidation of the fuel. The melted metal is finally poured into moulds.—W. G. M.

Improvements in Vessels or Baths for Galvanising, Tinning or Coating Iron or other Metal. William Henri Luther, Glasgow. Eng. Pat. 2126, February 16, 1885. 8d.

THE improved vessels consist of long troughs of cylindrical or other section, but with a contracted mouth running longitudinally, and fitted with vertical bars

placed at intervals to act as guides to the plates being dipped. The troughs are made either in one piece or of welded plates (not riveted), and are set in a flue running the entire length of the vessel, and communicating at one end with the fire-grate, and at the other with the chimney stack.—W. G. M.

Improvements in the Manufacture of Refractory Materials and other Fire-resisting Articles suitable for Lining Furnaces and Converters, and for other Uses. W. J. A. Donald, Glasgow. Eng. Pat. 2775, March 2, 1885. 6d.

IRISH lauxite or alum clay is calcined and then ground with sufficient milk of lime to form a paste. The product may be used for lining and cementing furnaces, in the manufacture of refractory bricks, retorts, crucibles, etc. A small quantity of uncalcined clay may in some cases be mixed with the calcined lauxite.—E. G. C.

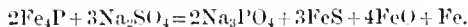
Improved Metallic Etching for Producing Designs in Relief and in Two Colours. Alfred Piper, Wolverhampton. Eng. Pat. 3419, March 17, 1885. 8d.

UPON a surface prepared by electrolytically depositing one metal upon the surface of another of different colour, the design to be produced is painted in an acid-resisting medium, such as asphaltum varnish. The plate so prepared is then immersed in an acid which will attack the deposited metal where unprotected by the varnish. On removing the varnish by means of a suitable solvent, the design appears in relief in the plating metal on a frosted ground composed of the base metal.

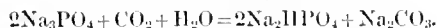
—W. G. M.

Improvements in the Extraction of Compounds of Phosphorus from Phosphide of Iron or "Ferro-Phosphor." W. P. Thompson, Liverpool. From Luigi Imperatori, Düsseldorf, Prussia. Eng. Pat. 3761, March 24, 1885. 6d.

SOME works in Germany produce a pig-iron, containing ten to fifteen per cent. of phosphorus, which is known in the market as "ferro-phosphor." This invention relates to the extraction of phosphorus from that material in the form of alkaline phosphates. The process is as follows:—The crushed material is mixed with calcined potassium or sodium sulphate in such proportions that the alkali can combine with the whole of the phosphorus to form a normal phosphate. The mixture is placed in an ordinary rotating black-ash furnace and heated with continuous agitation to a low red heat. The phosphorus is oxidised to phosphoric anhydride, and the alkaline sulphate reduced. Sulphide and oxide of iron are produced at the same time, thus—



As soon as the mixture is fused it is discharged, and after cooling lixiviated with water at 30° C. The solution is concentrated and allowed to crystallise, whereby tribasic sodium phosphate ($\text{Na}_3\text{PO}_4 + 12\text{H}_2\text{O}$) is obtained. The crystals of the tribasic salt exposed to an atmosphere of carbon dioxide are converted into bibasic sodium phosphate and sodium carbonate, thus—



The crystals can be separated by crystallisation. The bibasic sodium phosphate may also be treated with an equivalent of calcium sulphate, whereby bibasic phosphate of lime and sodium sulphate are obtained. Or, the bibasic sodium phosphate is mixed with an equivalent of ammonium sulphate, to produce ammonium sodium phosphate. From the residues (iron sulphide and oxide) the sulphur may be recovered or the residues may be mixed and roasted with common salt, whereby hydrochloric acid and sodium sulphate are obtainable. The process may be further simplified by running the molten iron phosphide into the revolving furnace, in which salt-cake has previously been placed, in this case the furnace needs no heating. The rotation mixes the ingredients, and after a few revolutions the reaction is complete. The mass is then discharged and treated as already described.—S. H.

XI.—FATS, OILS, AND SOAP MANUFACTURE.

Improvements in the Production of Compounds which may be usefully employed for the Destruction of Insects on Plants or Animals, as Lubricants, for Sheep-dipping, and generally as Soaps or Detergents for Washing, Cleansing, and Purifying Purposes. C. T. Kingzett. Eng. Pat. 2210, February 17, 1885. 6d.

CRUDE turpentine or rosin is dissolved in sanitas-oil, or rosin-spirit, or rosin-oil, and is then saponified by caustic alkali solution, sp. gr. 1.300. Camphor is added to ensure a permanently fluid product, which is medicated by the addition of disinfectants, such as thymol, etc.

—W. L. C.

Improvements in the Production of Compounds or Mixtures to be used for the Destruction of Insects; also for Washing Animals; and generally as Soaps or Detergents; and for Purifying Purposes. C. T. Kingzett. Eng. Pat. 3855, March 25, 1885. 4d.

PETROLEUM spirit or thymol, with or without sanitas oil, etc., is mixed with rosin, or rosin oil, which is then saponified with caustic soda.—W. L. C.

Improvements in the Production of Liquid Soaps and other Liquids, which may be usefully employed as Insecticides; also for Washing Animals, and for Preserving and general Purifying Purposes. C. T. Kingzett. Eng. Pat. 3894, March 26, 1885. 6d.

ROSTIN or crude turpentine is dissolved in alcohol, and saponified by potash. To this may be added an alcoholic solution of a fatty-acid soap, and various disinfectants, etc., as well as the products mentioned in the two patents described above.—W. L. C.

A New or Improved Method of Scouring or Removing the Oil from Animal and Vegetable Substances by means of Infusorial Earth and Heat. L. A. Groth. Eng. Pat. 3977, March 25, 1885. 4d.

THE substance to be cleansed is heated with infusorial earth to 15° above the melting-point of the oil, and the whole is then washed with hot water.—W. L. C.

Improvements in Treating or Utilising Soap-suds. J. H. Ashwell. Eng. Pat. 6667, June 2, 1885. 4d.

TO liquor strongly charged with soapy or fatty matter, caustic or carbonated alkali is added, and the whole is kept at 125° F. A scum which rises is removed and decomposed by mineral acids, while the clear liquid is decolourised by animal charcoal, and used over again.

—W. L. C.

Improvements in Sheep-wash. R. Morris and W. G. Little. Eng. Pat. 14,098, November 18, 1885. 4d.

THE addition of glycerine to finely-divided solids, such as flowers of sulphur or white arsenic, when suspended in water, prevents them from aggregating together into a hard mass.—W. L. C.

XII.—PAINTS, VARNISHES, AND RESINS.

Improved Anti-fouling and Preservative Composition for Coating Ships' Bottoms, etc. J. S. Gisborne, Walthamstow. Eng. Pat. 312, January 9, 1885. 4d.

THIS composition, which may be applied in the usual way by a brush or otherwise, consists of the following ingredients:—Mercury, 10lb.; litharge, 9lb.; blende, zinc-white, white- or red-lead, or other like material, 14lb.; chalk (preferably in a finely-divided state) 15lb.; boiled linseed oil sufficient to form a pigment of the required consistency.—E. G. C.

An Improved Paint or Pigment. W. R. Lake, London. From J. P. Perkins, Illinois, U.S.A. Eng. Pat. 8737, July 20, 1885. 4d.

SILICATE slag from iron furnaces is extremely finely comminuted, when it unites with oil or other vehicles to form a product "having in a high degree all the valuable properties of iron paint, and having better flowing and

enduring qualities than any other iron-paint compound hitherto produced." Portions of the slag are selected, consisting of silicate of iron in a practically pure state, or with but a small admixture of foreign substances.

—E. G. C.

An Improved Varnish or Size. W. Macrom, Glasgow. Eng. Pat. 9413, August 7, 1885. 2d.

THIS varnish is suitable for sizing wall and other papers, fabrics, etc., preparatory to decorating them with dry colours; for waterproofing paper, felt, and other fabrics; and as a substitute for, or for mixing with, varnishes at present in use, in the manufacture of letterpress and lithographic printing inks, and for mixing with oil paints to secure against "skinning" while in bulk. The names of the ingredients of the varnish or size, and their approximate proportions, are as follow:—Odourless seed oil, 72 parts by weight; resin, 32; paraffin wax, 16; beeswax, 4; copal varnish, 1.—E. G. C.

Improvements in the Manufacture of Dry Colours. W. Macrom, Glasgow. Eng. Pat. 9414, August 7, 1885. 2d.

THE inventor dissolves aniline or other colouring substances in water or in methylated spirit (or in a mixture of the two), incorporates the dissolved colours with ground tale, kneads and dries by heat or exposure to the air, and finally pulverises them.—E. G. C.

Improvements in Machinery for Making Tubing and Cord of India-rubber, and other Materials, in a Plastic State. A. W. L. Reddie, London. From V. Royle and J. Royle, jun., Paterson, New Jersey, U.S.A. Eng. Pat. 10,357, September 1, 1885. 6d.

COMBINED with the pressure cylinder, presser and die of a machine for making tubing or covering wire, is a core made separate from the presser, with a core-bridge adjustable transversely to the axis of the core and die. The core-bridge serves to "adjust the core concentric with the die." Various other improvements are detailed in the specification.—E. G. C.

Improved Process of Hardening Balsams, Resins and Resinous Compounds or Products, Fats, Oils, Tar, Pitch and Bituminous Products. A. M. Clark, London. From Wirth & Co., Frankfort-on-the-Main. Eng. Pat. (amended November 30, 1885) 8036, May 21, 1884. 6d.

NATURAL pine resins and balsams, and the products obtained from the same, also fossil resins of the recent period, are found to attain a higher softening point when the acids contained in them are made to combine with caustic lime and other caustic alkaline earths, either partially or wholly. Fats, oils, pitch, and different kinds of tar can also be brought to a higher softening point, if mixed with resins, which have been hardened as above described. Alkalis must not be used in this process; in fact, by rendering the mass greasy, and forming with the resin a soap soluble in water, they do more harm than good.—E. G. C.

XIV.—AGRICULTURE, MANURES, Etc.

Direct Fixation of Atmospheric Nitrogen by Certain Argillaceous Soils. M. Berthelot. Compt. Rend. 101, 775—784.

THE source of the nitrogen compounds present in soils has long been discussed, but the question is still undecided. It appears certain that the loss of nitrogen by the decay of plants and the removal of crops, is not entirely compensated by the gain due to the nitric acid and ammonium nitrite formed in the atmosphere by the passage of electricity. The experiments described by the author show that certain soils have the power of absorbing free nitrogen from the air. Five distinct series of experiments were carried out simultaneously during two years, four different argillaceous soils being made use of.

Each kind of soil was simultaneously subjected to the following conditions during the two years:—(1) A portion of each was allowed to remain in a well-lighted room, the walls of which were newly cemented; (2) a portion was placed in a meadow under shelter; (3) a portion was placed on the top of a tower, 28 metres high, without shelter; (4) a portion was placed in vessels hermetically sealed; (5) a portion was subjected to sterilisation by heating.

Analyses of combined nitrogen (by the soda-lime process) of ammonia, of nitrates, and also of moisture, were made from time to time, and the results are given in the tables in the original paper.

(1.) The soils were placed in open glazed earthenware pots, each pot containing 50 to 60 kilos., and were kept in a dry, well-lighted room, freshly cemented on all sides. It was found that there was a continuous increase of combined nitrogen during the summer months, but not in winter, but that it bore no relation to the amount of ammonia or of nitrates, which sometimes increased slightly and sometimes decreased.

(2.) Glazed porcelain pots perforated at the bottom, and containing 1 kilo. of soil, were placed in a meadow, on trestles, under a small roof, to protect them from vertical rain. During dry weather they were watered with distilled water, the nitrogen in which had been determined.

(3.) Similar pots were placed on boards on the top of a tower, and were exposed to rain. During the whole period rain was collected in vessels of known surface, standing near the pots, and the nitrogen was determined. Atmospheric ammonia was also estimated by absorbing it in sheltered vessels, containing dilute sulphuric acid. The nitrogen absorbed by the soils was from four to eight times as great as the total nitrogen in the rain and in the atmosphere.

(4.) The soils were placed in white glass flasks, of four litres capacity, filled with air, and containing 1 kilo. of soil. The flasks were closed with ground stoppers, and some were kept in the dark, some exposed to light. A little water was added at first.

In all these cases there was a gradual increase of combined nitrogen, and since its amount bears no relation to that of ammoniacal nitrogen, or of the nitrogen of nitrates, it is clear that the element cannot be absorbed in the form of ammonia, or of nitrates, but as amido-compounds insoluble in water, such as are present in living organisms. The action, therefore, appeared to be due to micro-organisms; and this conclusion was borne out by the fact that after heating, the soils lost their power of absorbing nitrogen.

(5.) A kilo. of soil was placed in a flask of 4 litres capacity, and heated to a 100° for two hours, and finally exposed to the action of a current of steam for five minutes. The air which entered on cooling was filtered through cotton wool, soaked with hot glycerol. Even when exposed to the free air, and after a small quantity of unsterilised soil had been added, no increase of nitrogen was observed.

The subjoined table shows the general results of the research.

Substance.	Initial Nitrogen.	Closed Flask in light.	Closed Room.	Meadow.	Tower.
Yellow Argillaceous Sand	0.0910	0.1289	0.1179	0.0983	—
Yellow Argillaceous Sand	0.1119	0.1503	0.1639	0.1295	0.1396
Crude Kaolin	0.0210	0.0494	0.0407	0.0353	0.0557
Kaolin	0.1065	0.1236	—	0.1144	0.1497

The quantities of nitrogen are in grms. per kilo., and the increase was for the season, April to October, 1885.

According to Lawes and Gilbert, the gain of nitrogen due to salts dissolved in rain amounts to Skilos. per hectare, while at Montsouris the quantity was estimated at 1.7 kilos. per hectare. The quantity lost by the soil by the removal of crops, amounts to 50 to 60 kilos., so

that there must be a total loss of at least 40–50 kilos. per hectare. M. Berthelot calculates that, at the lowest estimate, the gain by absorption of free nitrogen is from 20 to 32 kilos., an amount which would be nearly, if not quite sufficient to balance the annual loss.

Papers have since been published by M. Joulie (*Compt. Rend.* 101, 1008–1011, and by M. Deherain, *Compt. Rend.* 101, 1273–1276), embodying results which are confirmatory of M. Berthelot's, in so far that under certain circumstances the soils examined contained more nitrogen at the end than at the beginning of the season. M. Joulie found a very much greater increase with argillaceous soil than with sand, but in both cases there was in general an increase of nitrogen. Both these chemists grew crops on the soils experimented on. M. Deherain draws attention to the suggestion of Lawes, Gilbert and Warrington, that soils may possibly obtain nitrates from subterranean water, but this could not have occurred in either M. Berthelot's or M. Joulie's experiments.—S. Y.

Utilising Basic Cinder as Manure. J. M. H. Munro, Downton; and T. Wrightson, Stockton-on-Tees. Eng. Pat. 250, January 7, 1885. 6d.

THE basic cinder is ground and mixed with ordinary or high grade superphosphate, in quantities insufficient to completely precipitate the soluble phosphate of the latter. In this way a manure is obtained containing soluble, precipitated, and undissolved (cinder) phosphates, all of high fertilising value. The unoxidised sulphur of the basic cinder is expelled as sulphuretted hydrogen gas. The proportion of oxides of iron in the product is not excessive. The drying properties of the alkaline cinder may be taken advantage of by mixing the cinder with superphosphates containing excess of acid or moisture. The high manurial value of the phosphates contained in ground basic cinder has recently been demonstrated by several series of experiments.—J. M. H. M.

Converting Scrap and Old Leather into Manure. James Ross, Old Kent Road, Surrey. Eng. Pat. 1835, February 10, 1885. 8d.

THE leather scrap is introduced into a vessel with a false bottom, perforated with holes. Below this are two steam jets opposite to each other, and above the vessel is covered by a sliding hood, the apex of which is connected with a series of U-tubes for condensing the waste steam and the ammonia evolved during the process. Sometimes horse-hoof parings are added to the old leather. The grease from the leather is liquefied, and collects in the space below the perforated plate. When the leather has been rendered sufficiently friable, it is ground to a powder, and sold as "torrefine."—J. M. H. M.

Preparing Phosphoric Acid for Use as Manure. François Barbe, 15, Rue Richelieu, Paris. Eng. Pat. 2193, February 17, 1885. 4d.

A SOLUTION of phosphoric acid, prepared by the action of sulphuric acid on bone phosphate, is evaporated to a syrup, which is absorbed by the addition of some porous material, such as finely-divided silica, infusorial earth, or sawdust.—J. M. H. M.

XV.—SUGAR, GUMS, STARCHES, Etc.

Source of the Presence of Raffinose (Mellitose) in the Products of the Manufacture of Sugar. E. von Lippmann. Ber. 18, 3087–3090.

IN furtherance of Tollens' investigations on the presence of raffinose in molasses, treated by the strontium process (this Journal, 4, 290), the author has successfully isolated this substance (which possesses such high rotating power on polarised light) from beet-juice, by subjecting the latter to the strontium process, as applied to the extraction of sugar from molasses. Hence the formerly supposed presence of raffinose in beet-juice is now an established fact.—D. B.

Improvements in the Process of Extracting Saccharine Matter. H. J. Haddan. From Conrad Frobach, Berlin. Eng. Pat. 1453, February 2, 1885. 6d.

THE molasses or other impure sugar solution is made into a solid mass by mixture with, and absorption by sawdust, or other finely-divided vegetable matter, and the mass is then lixiviated by strong alcohol. It is also preferred to treat the impure syrup previously to the above operations, by a modification of Marguerite's process, to remove sulphates.—A. J. K.

Improvements in Apparatus for the Decolorisation of Saccharine or other Liquor. Eng. Pat. 12,875, October 27, 1885. 8d.

Improvements in and relating to Bone-black Filters. Eng. Pat. 12,871, October 27, 1885. 8d.

An Improved Process and Apparatus for the Purification and Decolorisation of Sugar. Eng. Pat. 12,874, October 27, 1885. 8d.

All the above three Patents by W. R. Lake. From F. O. Mathiesen, New York.

THESE specifications relate to a process of continuous filtration of saccharine solutions upwards through a column of bone-black, to methods for supplying the liquor to the bone-black filters used, and to a description of the said bone-black filters, and of special apparatus for constantly removing the exhausted char and supplying its place by re-calcined bone-charcoal.—A. J. K.

XVI.—BREWING, WINES, SPIRITS, Etc.

An Improved Process of Brewing for obtaining Temperature or Non-intoxicating Beers. A. Manbré, London. Eng. Pat. 58, January 1, 1885. 6d.

THE inventor prepares beers from the ordinary brewing materials, which possess body and great nourishing properties, but only contain from 1 to 2 per cent. of alcohol. He makes his mash in a closed vessel, capable of resisting an internal pressure of 90 to 100 lb. per square inch, and in this he heats the malt (which is ground very finely, and the husk sifted out), or malt substitute with water to 175° F., until he finds that sufficient sugar has been formed to yield 1 to 2 per cent. of alcohol on fermentation. He then raises the temperature of the mash to 250–300° F. The worts so obtained are filtered, and then heated with the hops, or extract of hops, to the same temperature. After separation of the hops they are subjected to fermentation in the usual way. He claims that by heating the wort and wort and hops, to the above temperature, he renders the resulting beers more stable.—G. H. M.

Improvements in Preparing Gelatinised Grain for use in Brewing. J. Death, Cheshunt. Eng. Pat. 1032, January 24, 1885. 8d.

THE grain is gelatinised by means of a hot moist blast, which is obtained by injecting superheated steam into the flue of a smokeless fire. The blast is passed through cylinders, which contain the previously soaked grain. When the gelatinisation has reached a certain point the grain is withdrawn from the cylinders, and either dried on a malt-kiln and ground, or used direct in the mash-tun. Any kind or condition of grain may be used, and the time of steeping varies with the condition of the grain. The cylinders are made to revolve during the passage of the hot moist blast. A drawing of the furnace used, and a full description of the cylinders and other apparatus, accompany the specification.—G. H. M.

An Improved Method of, and Apparatus for Causing the Germination of Barley and other Cereals. W. R. Lake. From Gebr. Stollwerek, Cologne, Germany. Eng. Pat. 12,312, October 15, 1885. 8d.

THIS consists of an arrangement by means of which the temperature and aeration of barley, whilst undergoing germination, are placed under control. The barley or

other cereal, after being steeped in the usual manner, is placed in cylinders or drums, and the air passing through these is heated or cooled, as required, by previously circulating round pipes, filled with hot or cold water. The gases evolved during germination are removed either by an exhaustor or blower, which is connected with the heating and cooling arrangement. The apparatus employed is to some extent similar to that described in patents 1364 and 16,313, 1884, and aims at replacing the labour and uncertainty of working the grain upon the floors, as at present practised. Full descriptions and drawings of plant are given.—G. H. M.

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

(A) CHEMISTRY OF FOODS.

Improvements relating to the Preparation of Ferments. Moritz Blumenthal, Grünan, Berlin. Eng. Pat. 5483, May 5, 1885. 8d.

THE invention relates to the separation of pure ferments from the organisms or substances containing the same. It contains severe criticisms on the existing methods of obtaining pepsin and rennet. Practically, he claims the use of saline solutions, with or without acids—using no “preservative” agent as such—such as boric acid, borax, glycerine, etc. He avails himself of the solubility of pepsin in acids, and of the insolubility of chymosin therein, to produce these substances respectively in a state of comparative purity. There are seven claims in the patent.—T.

Improvements in the Preservation of Fruit. J. E. Taylor, Ipswich. From W. Peacock, South Melbourne. Eng. Pat. 14,233, November 20, 1885. 4d.

THE fruit is placed in an air-tight box, the air from which is displaced by sulphurous anhydride by admission from the bottom. The odour of the gas is expelled when the fruit is subsequently boiled.—C. C. H.

(B) SANITARY CHEMISTRY.

A New or Improved Process for the Manufacture of a Filtering, Deodorising, and Decolourising Substance from Carbonaceous or “Lignite” Clay. G. H. Ellis, Exeter. Eng. Pat. 908, January 22, 1885. 4d.

CERTAIN carbonaceous or “lignite” clays are first pulverised and then introduced into tanks containing dilute soda or borax. The tanks are heated to 100° C., the mixture being thoroughly stirred until it becomes thick or pulpy. The material is then removed and spread upon drying floors, and after drying is broken up into rough lumps and carbonised in suitable retorts or ovens. During this operation, any sulphur present is removed by passing steam freely through the material. The desulphurised material is finally quenched in water, dried and granulated.—E. G. C.

Improvements in the Filtration and Purification of Liquids. J. G. Lorrain, London. Eng. Pat. 2352, February 21, 1885. 8d.

SPONGY platinum or platinum-black is deposited on extended porous surfaces, or on woven fabrics, and so exposed in a filter that a portion of the filtering surface is exposed to the action of the air. It is proposed to free water containing sewer gases from these gases by filtering the water through such a medium. The patentee shows seven different methods of forming his “platinised carbon” filters.—C. C. H.

Filtering Water or other Liquids. A. J. Bell, Manchester. Eng. Pat. 2746, March 2, 1885. 8d.

THE inventor places filtering material between two perforated plates, and, with a filter so constructed, closes the area of a water cistern near its upper edge, so that

all the incoming water must be partly filtered before it reaches the lower part of the cistern. He next secures in that lower part a series of similarly constructed upright filters, arranged in pairs with hollow spaces between, where the water collects after the second filtration, and is then withdrawn in a purified state.—B.

Improvements in the Method or Process of Treating Liquids or Solutions, etc., with Atmospheric Air and other Gases, in order to produce Oxidation, etc. W. F. B. Massey-Mainwaring and J. Edmunds, London. Eng. Pat. 2884, March 4, 1885. 8d.

A PORTION of the liquid is first highly oxygenated by forcing through it, in a closed vessel, compressed air; and a further portion of it is similarly purified by the introduction into its mass of the first part treated as above described.—C. C. H.

Improvements in the Treatment and Purification of Sewage. W. F. B. Massey-Mainwaring and J. Edmunds, London. Eng. Pat. 2885, March 4, 1885. 8d.

THE sewage may be first defecated by any of the methods well known, after which the effluent from the settling tank is oxidised by the injection of water, or any other liquid, which has been previously highly charged with oxygen under pressure. Rapid oxidation of the organic matter contained in it, is stated to be the result.—C. C. H.

Improvements in Disinfectant and Cleansing Liquid. H. Endemann, Brooklyn. Eng. Pat. 14,391, November 24, 1885. 4d.

THREE HUNDRED gallons of coal-tar oil 1.04 specific gravity, and 100 gallons of spirits of wood tar 0.930 specific gravity are mixed. To 100 gallons of this mixture are added 200lb. of oleic soap, prepared with caustic potash, and containing 43 per cent. of oleic acid. To the whole bulk of the mixture are then added 435lb. of potash solution, prepared by dissolving 6 parts of caustic potash with 46 parts of water.—C. C. H.

Purification and Filtration of Waters, Sewage, and other Liquids. P. Smith and R. Wild, Manchester and Littleborough. Eng. Pat. 16,514, December 16, 1884. 6d.

ONE gallon of a solution of “aluminous cake,” or sulphate of alumina, is added to every 50 gallons of water or sewage, and the effluent is passed through an improved filter, the upper part of which is provided with an open or covered receiving tank. From this tank or chamber, the fluid passes downwards through a perforated grating, and through the filtering materials found most suitable (by preference charcoal or carbon), then through another grating, covered with cotton, linen, or asbestos cloth, into a chamber beneath, from which the filtered water rises into a suitable pipe, passage, or chamber, which is the outlet. After rising to a suitable height, as may be most convenient, the fluid is allowed to overflow and pass into a stream.—E. G. C.

(C) DISINFECTANTS.

Improvements in Disinfectants. J. C. Stevenson, M.P., Westoe. Eng. Pat. 2739, February 28, 1885. 4d.

BISULPHATE of soda, containing about 40 per cent. of sulphuric acid, is mixed with manganate of soda, and the whole finely ground. When brought into solution, the acid salt of soda acts in precisely the same manner in the production of the permanganate salt as if free sulphuric acid had been employed.—C. C. H.

XVIII.—ELECTRO-CHEMISTRY.

Improvements in Galvanic or Primary Batteries. C. M. Newton, Tulse Hill, London. Eng. Pat. 1088, January 26, 1885.

IN galvanic or primary batteries, the author uses oxide of lead as a depolarising body, together with a single liquid or solution of caustic potash or caustic soda, or a mixture of both these caustic alkalis, as an exciting liquid.—W. B.

Improvements in Secondary Batteries. J. S. Sellon, London. Eng. Pat. 1764, February 9, 1885.

AN invention in secondary batteries to obviate the occurrence of contacts between the negative and positive elements by the coming together of the plates at any point or points, or the falling off or out therefrom of packed material, and to obtain arrangements by which the plate or all the plates of either pole in a cell may be, with facility, removed and examined, and be readily replaced for any required purpose; and also, that an effective and economical battery can be so constructed that it may occupy a minimum of space. The elements or plates of one pole are placed transversely through openings in the elements or plates of the other pole.

—W. B.

The Construction of Storage or Secondary Batteries or Electric Accumulators. W. Symons, Barnstaple. Eng. Pat. 2747, March 2, 1885.

BATTERIES are constructed chiefly or entirely of carbon in plates, rods, or cylinders, in which cavities or spaces are made for containing oxide of lead or other suitable material. The carbon plates are connected together in proper series, either by simple pressure or gravity, or by plates or wires of silver or other conducting material not acted upon by the liquid.—W. B.

Improvements in Secondary Batteries. H. J. Allison, London. From P. Benjamin, New York. Eng. Pat. 2795, March 3, 1885.

THIS invention consists of a new secondary or storage cell in which a liquid is used consisting of a solution of zinc sulphate, to which magnesium oxide is added, and electrodes specially compounded or prepared.—W. B.

Improvements in Secondary Batteries or Accumulators. J. Pitkin, Clerkenwell, Middlesex. Eng. Pat. 3260, March 12, 1885.

THIS patent relates to the construction of the elements of a voltaic battery, the combination with a conductive plate or other form of conductor, of one or two perforated plates of non-conducting material, enclosing one or both faces of the conducting plate and intermediate distance pieces, frames, ribs or flanges, the whole united by bolts of non-conducting material, for the purpose of holding the active material in contact with the conducting plate.

—W. B.

Improvements in Electric Batteries. W. R. Lake, London. From H. L. Brevort and I. L. Roberts, Brooklyn, New York. Eng. Pat. 3798, March 24, 1885.

A BATTERY carbon and a reservoir or liquid-holder are arranged in an electric battery at the upper portion of the said carbon, and communicating with the pores or interstices of the carbon, so that liquid will be supplied from it to the carbon, and will percolate thence towards the liquid in the cell of the battery.—W. B.

An Improved Galvanic Battery. H. J. Allison, London. From E. M. Gardner, Massachusetts, U.S.A. Eng. Pat. 12,170, October 13, 1885.

THE principal of this invention is to provide a partition in a galvanic cell which shall offer the least resistance to

the current, and at the same time ample path for the transference of matter, and which shall be of a material not itself chemically alterable by or capable of chemically altering the fluids in which it is immersed. Carbon being an electrical conductor, and affording a path through its substance for the current, while the hydrogen passes through its pores, is found to be most suitable.—W. B.

XIX.—PAPER, PASTEBOARD, Etc.

An Improved Process of Preparing a Lye for and Method of Extracting Cellulose from Wood. From August Fellner, A. Albutt, Eng. Pat. 16,186, 6d.

THIS process consists in heating wood to a temperature of 150° C., with a solution obtained by acting upon magnesite and dolomite, either together or singly, with sulphurous acid.—E. J. B.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

Piperidine from Pentamethylenediamine. A. Ladenburg. Ber. 18, 3100—3102.

THE author has effected the decomposition of pentamethylenediamine into piperidine and ammonia by subjecting pentamethylenediamine hydrochloride to distillation.—D. B.

XXII.—GENERAL ANALYTICAL CHEMISTRY.

Drying and Heating Apparatus for Chemical Laboratories. V. Meyer. Ber. 18, 2999—3002.

THIS apparatus consists of a small jacketed cylindrical copper bath with elliptic base resting on three legs. To maintain a uniform temperature in the bath the jacket is charged with a small quantity of a liquid having a constant boiling point. The bath is then heated gently in order to vaporise the liquid. To prevent loss by evaporation a small condensing tube is fitted into the top of the jacket. As heating agents the following substances are used:—Water gives a temperature of 97° in the interior of the bath, toluene gives 107°, xylene 136°, anisole 150°, and coal-tar cumene 161—162°. For temperatures above 200° naphthalene may be employed. The apparatus may be procured from C. Desaga of Heidelberg.—D. B.

Estimation of Phosphorus in Iron and Steel. J. B. Mackintosh. Trans. Amer. Inst. Mining Eng. 1885.

THE general method has been to dissolve the sample in some oxidising agent, in order to convert the phosphorus into phosphoric acid. M. Y. Lantin (*Chem. News*, xviii, p. 252), however, proposed to liberate the phosphorus as hydrogen compound, by attacking the metal with hydrochloric acid. The evolved gases were passed first through potash solution, and then through silver nitrate solution, by which the phosphorus carried over was obtained as silver phosphide, which was treated with nitro-hydrochloric acid, and the phosphoric acid resulting determined as magnesium pyrophosphate. The author found that the whole of the phosphorus was not obtained by Lantin's method; only a portion of it going over as gas, the remainder occurring partly in the insoluble residue, and partly in solution in the dissolving flask. On taking the solution from the dissolving flask and attempting to precipitate the phosphorus with a little iron as basic phosphate by means of an alkaline acetate, it was found that only a portion of the phosphorus in solution could be thus precipitated. Thus, a pig-iron containing 0.880—0.885 per cent. of phosphorus was found to give only 0.771 when the solution was treated with alkaline acetate without previous oxidation, although the phosphorus left in the residue and that carried off in the gaseous state were included. In this experiment the gases evolved were not passed through potash and silver nitrate solutions, these being replaced

by an acidulated solution of potassium permanganate. A current of oxygen was passed through the apparatus during the time the iron was dissolving, but the low result obtained shows that oxygen alone was not sufficient to convert the whole of the phosphorus dissolved into a form precipitable by alkaline acetate. That the loss of phosphorus is due to defective oxidation, the author shows by taking half the solution obtained in several experiments and oxidising by means of nitric acid and potassium chlorate, and afterwards precipitating with acetate; in this way the whole of the phosphorus could be accounted for, so that the problem resolved itself into finding a method of converting the lower oxygen compounds of phosphorus into phosphoric acid, without simultaneously oxidising ferrous to ferric iron. This led to a satisfactory method, of which the following is a brief outline:—

"1. Solution in hydrochloric acid in a stream of oxygen or air, absorbing the escaping gases in potassium permanganate acidified with sulphuric acid. 2. Heating the solution to boiling, stopping the passage of the oxygen current, and carefully adding an excess of sulphurous acid solution, and continuing the boiling till the precipitated MnO_2 in the absorption flasks is redissolved. This boiling should last several minutes to ensure the completion of the reaction." 3. Disconnecting and allowing to cool. "4. Mixing solutions, filtering out residue, which is placed (with filter paper) in a porcelain capsule, oxidising with nitric acid and potassium chlorate, and evaporating to dryness. 5. Boiling the solution till the excess of sulphurous acid is expelled," and precipitating the phosphorus as iron phosphate along with a little basic iron acetate, by means of alkaline acetate. The filtrate is again boiled, by which a further precipitate of basic iron acetate is obtained which ensures the obtainment of all the phosphoric acid. 6. Dissolving these precipitates in hydrochloric acid and adding this to the solution of the residue in which, by this time, the paper will have been thoroughly destroyed. 7. Evaporating to dryness for silica, and proceeding as usual to precipitate the phosphorus as ammonia-phosphomolybdate by means of ammonium molybdate in a nitric acid solution in presence of ammonium nitrate. The less phosphorus is present the less time is required by this process in comparison with other methods of estimating phosphorus.—J. T.

New Books.

OUTLINES OF ORGANIC CHEMISTRY. By H. FORSTER MORLEY, M.A., D.Sc., Fellow of, and Assistant-Professor of Chemistry at University College, London. London: J. & A. Churchill, 11, New Burlington Street, 1886.

8vo volume containing preface, table of contents, and 471 pages of subject matter. Finally, follow a SUMMARY OF GENERAL REACTIONS, a LIST OF EXPERIMENTS to be performed by the student, subdivided into Tests and Preparations, and an ALPHABETICAL INDEX. The Table of Contents furnishes a key to the arrangement of the work, which is briefly indicated as follows: Analysis; Methyl Compounds; Ethylic Alcohol; Acetyl Compounds; Ethyl Compounds; Compounds containing Nitrogen; Compounds containing Phosphorus; Compounds containing Metals; Homology and Isomerism; Compounds containing two Hydroxyls and bodies related to them; Glycerine Group; Starch and Sugar Group; Cyanogen Group; Polybasic Acids; Unsaturated Compounds; Chlorinated Compounds; Amido Acids; Oxy-Acids; Uric Acid Group; Derivatives of Cyanamide; Sulphocyanides. DERIVATIVES OF BENZENE: Benzene; Homologues of Benzene; Nitrosamines; Nitroso Compounds; Azo Compounds; Hydrazines; Phenols; Benzyl Compounds; Carboxylic Acids; Compounds with two Benzene Nuclei; Rosaniline; Phthalein Group; Indigo; Azo-colouring Matters. DERIVA-

TIVES OF NAPHTHALENE. DERIVATIVES OF PHENANTHRENE. DERIVATIVES OF ANTHRACENE. DERIVATIVES OF THIOPHEN. ALKALOIDS. Tobacco; Hemlock; Opium; Nux Vomica; Cinchona; Sabadilla; Monkshood; Deadly Nightshade. DERIVATIVES OF PYRIDINE. TERPENES. UNDEFINED COMPOUNDS. BILE. PHYSICAL CONSTANTS.

LEHRBUCH DER KOHLENSTOFFVERBINDUNGEN, ODER DER ORGANISCHEN CHEMIE. VON CARL SCHÖRLEMMER. Dritte verbesserte Auflage. Mit eingedruckten Holzstichen. Erste Hälfte. Braunschweig. Druck und Verlag von Friedrich Vieweg und Sohn, 1885.

THE above is the first half of the entire work, and commences with an "Einleitung," which is treated as part of the text and is mainly devoted to a criticism of the older method of dividing the science into Inorganic and Organic Chemistry, finally disclosing the more correct title for the latter division, as the Chemistry of the Carbon Compounds. The text covers 471 pages of the small 8vo volume, and this the first half of the work concludes with the Sugars, Dextrin, Pyrrrol, etc., and lastly a "Nachtrag" treating of the "Nitroso- und Isonitrosoverbindungen."

DIE GESAMMTE INDIGO-KÜPENBLAU-FAERBEREI, RESERVAGE UND NETZ-DRUCKEREI (BLAUDRUCK) AUF BAUMWOLLE UND LEINEN. Enthaltend die in neuerer und neuester Zeit in Aufnahme gekommenen Herstellungsmethoden, Reservagen und Aetzungen, auch farbige, auf indigoblauen Grunde. Nach Mittheilungen und Notizen von Persoz, Mercer, Walter Crum, Thompson, Prudhomme, O. Scheurer, Saget, Witz, D. Köchlin, A. Schulz, Fries, Bourcart, Jos. Dépierre, J. Ribbert, Schlieper and Baum, Ernst, Chadwick, u. Anderen. Gesammelt und zusammengestellt, von E. RUDOLF, Leipzig. Verlag von Gustav Weigel, 1885.

SMALL 8vo volume in paper cover. Price, 6s. (6 Mark). It contains a brief preface, table of contents, and 104 pages of subject-matter devoted to a compilation of the best methods of dyeing and printing with indigo, according to the writings or recipes of the above-named authorities.

THE CHEMISTRY OF THE COAL-TAR COLOURS. Translated from the German of Dr. R. BENEDIKT, and edited, with additions, by E. KNECHT, Ph.D., Head Master of the Dyeing Department of the Technical College, Bradford; Editor of the *Journal of the Society of Dyers and Colourists*. London: George Bell & Sons, York Street, Covent Garden, 1886.

8vo volume bound in cloth, and forming one of the well-known series of Technological Hand-books. The work contains a preface, table of contents, and subject matter filling 243 pages. An alphabetical index concludes the work. A fairly correct idea of the matter contained in the text and of its sub-division, is conveyed in the following excerpt from the Table of Contents: The Optical Properties of Colouring Matters; Absorption Spectra of the most perfect Colouring Matters; General Chemical Properties of the Colouring Matters, Methods for Dissolving the Colouring Matters. Dyeing with Coal-tar Colours. The Relations of the Fibres to Colouring Matters; the Testing of Colouring Matters; Coal Tar; the Coal-tar Colours; I. Aniline Dyes; II. Phenol Dye-stuffs; III. The Azo Dyes; IV. Artificial Indigo; V. the Anthracene Colouring Matters.

Monthly Patent List.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

1885.

- 1001 A. J. Boulton, London.—Communicated by G. A. Heiser, Germany. Improvements in smoke consuming furnaces and boilers. January 22
- 1037 J. L. Wade, Glasgow. An improved compound for preventing and removing incrustation in steam boilers. Jan. 23
- 1228 H. Thompson, London. Improvements in furnaces. January 27
- 1213 A. Fould and P. Genreau, London. Manufacture of refractory bricks, tiles, tubes, crucibles, furnace linings, and other articles subjected to high temperatures. January 27
- 1352 H. Scott, Newcastle-on-Tyne. Improvements in and connected with furnaces, whereby chimneys are dispensed with, and the heating properties of coal, coke, and other fuel increased, and the smoke entirely consumed. January 30
- 1391 H. Maus, London. Improved apparatus for feeding furnaces with fuel without at the same time admitting air. January 30
- 1420 J. Payne, Cardiff. The coating of steam pipes, hot-water pipes, hot-air pipes, cold-water pipes, and steam boilers, for the retention of heat and exclusion of cold. February 1
- 1436 H. Kosicke, London. Improvements in smoke-consuming furnaces. Complete specification. February 1
- 1490 W. Mills, T. Pickup, and G. Procter, London. Improvements in apparatus for the separation of smoke from the gases evolved during the combustion of fuel. February 2
- 1517 J. S. Badia, London. Improvements in automatic apparatus for generating gases. Complete specification. Feb. 2
- 1613 B. W. Maughan, London; and S. F. Sloper, Wandsworth. Improvements in apparatus for cooling and heating air or water or other liquids, and the production of heat and light. February 4
- 1794 W. B. G. Bennett, London. Improvements in apparatus for mixing or incorporating solid and liquid matters, and for effecting or controlling the supply of the matters to be mixed, and for effecting or controlling the discharge of the same when mixed. February 6
- 1990 J. Mactear, Glasgow.—Communicated by J. Kolb, France. Improvements in raising liquids, and in apparatus therefor. February 11
- 2056 W. F. Bower, Peckham. Cooling liquids of any description by compressed air. February 12
- 2091 C. G. P. de Laval, London. Improved centrifugal apparatus that can be operated by hand for separating substances of different gravities, such as milk and cream. February 12
- 2096 J. Maugnnli and W. Bratby, Manchester. An improved system of saturating liquids with or exposing them to the action of gases, and apparatus connected therewith. Feb. 13
- 2137 J. Marx, London. Machinery or apparatus for effecting the separation of liquid from solid matter. February 13
- 2168 G. Behrens, London. Improvements in filtering apparatus. Complete specification. February 15
- 2182 F. Grosvenor, Glasgow. Improvements in filters or water purifiers. Complete specification. February 15
- 2252 L. Douillet, Liverpool. Improvements in metallic casks or drums. Complete specification. February 16
- 2376 S. Fox, London. Improved means of preventing incrustation of certain parts of steam boilers. February 18
- 2401 G. M. Capell, London. An improved construction of apparatus for effecting industrial desiccation. February 18
- 2478 A. Higginson, Liverpool. Improvements in the construction of steam generators, furnace flues, and like structures. February 20
- 2503 J. Gray, Glasgow. Improvements in centrifugal machines for separating fluids of different specific gravity. February 20

COMPLETE SPECIFICATIONS ACCEPTED.*

1885.

- 3055 R. J. Friswell and A. Myall. Filter presses. Feb. 16
- 3740 J. Price, jun. Apparatus for heating or cooling liquids, condensing steam, and for like purposes. February 2
- 3924 L. W. Sutcliffe. Self-feeding and smoke-consuming furnaces and appliances for heating muffles and drying stoves, etc. January 26
- 4377 T. W. Barber. A tyure apparatus for supplying and heating blast. January 26
- 4710 M. Keenan. Non-conducting composition for protecting boilers, cylinders, pipes, etc., against radiation. Feb. 2
- 4711 M. Keenan. Means for protecting boilers, cylinders, pipes, etc., against radiation. February 2
- 4831 C. Jones. Improvements in apparatus used when heating vessels or chambers by steam-heated jackets. February 16
- 15865 W. R. Jones. Duplex furnaces specially adapted for burning breeze and inferior fuel. February 16

15873 F. Bruggemans and L. Donkers. Improvements in or applicable to internally heated boilers, for the purpose of economising fuel. January 26

1886.

599 N. Evans. Apparatus for supplying air to furnaces and combustion chambers, especially steam generators. February 16

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

- 996 G. Waller, Westminster. Improvements in gas retort lids, mouth-pieces, and fastenings. Complete specification. January 22
- 1226 J. West, Westminster. Improvements in machinery or apparatus for charging and drawing gas retorts. January 27
- 1367 G. Kinnaird, Glasgow. An inodorous gas calorific, for use also with oil, spirit, or other substances. January 30
- 1459 J. L. Balfour and J. Lane, London. Improvements in the manufacture of illuminating gas and volatile liquid hydrocarbons. February 1
- 1461 J. J. R. Humes, London. Improved means for mixing and igniting combustible charges operating liquid hydrocarbon engines. February 1
- 1543 G. Ignatieff, London. Improvements in electric candles. February 2
- 1556 C. Pilla, London. Improvements in the manufacture of gas, and apparatus therefor. February 2
- 1695 D. Yates, Halifax. Improvements in the manufacture of fire-lighters. February 5
- 1711 R. W. Hewett, Birmingham. Improvements in the application of an exhaust or egressing current of air obtained from a fan, blower, bellows, or exhauster, for the better consumption of fuel and economy of heat in firebricks, stoves, furnaces, steam, and other boilers. February 5
- 1807 W. S. Morland, Hempstead, Gloucester. An improved method of removing and discharging the material used in gas purifiers. February 8
- 1960 A. G. Holbrook, Westminster. Improvements in machinery and apparatus for charging and drawing gas retorts. February 10
- 2045 P. Smith and R. Wild, Manchester. Improvements in the means and method for lighting and illuminative purposes. February 12
- 2270 A. Kitt, London. Improvements relating to the manufacture of coal-gas. February 16
- 2307 H. Barclay and R. Simpson, Harrington, Cumberland. Improvements in the manufacture of coke for metallurgical purposes. February 17
- 2411 A. Dempster, Elland, Yorks. Improvements in centre valves for working purifiers and other apparatus used in the manufacture of coal-gas. February 18
- 2412 A. Dempster, Elland. Improvements in apparatus, and in the means used in purifying coal-gas. February 18
- 2498 G. Beard, Glasgow. Improvements in heating feed water, and in utilising the waste heat of what are sometimes known as "low-heating furnaces" and other furnaces. February 20
- 2572 W. Kemble, London. Improvements in apparatus for regulating the production and delivery of gas from gas-making apparatus. February 22

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 3790 W. Black. Manufacture of briquettes or fuel blocks. February 2
- 2570 R. Dempster, jun. Condensers used in the manufacture or purification of gas. February 12
- 4411 W. Black. Treating coal dross and other carbonaceous substances. February 2
- 4461 A. Klonne. Improvement in gas washers called column washers. February 16

1886.

- 451 J. Parkes. Apparatus for enriching illuminating gas. February 16
- 996 G. Waller. Gas retort lids, mouth-pieces, and fastenings. February 23

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, ETC.

APPLICATIONS.

- 1016 H. Kenyon, Manchester. Improvements in the distillation and decomposition of coal, shale and other matters, to obtain illuminating gas and other products. Complete specification. January 23
- 1017 H. Kenyon, Manchester. Improvements in ovens or retorts and connected apparatus for use in the distillation and decomposition of coal, shale, and other matters. Complete specification. January 23

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 4902 A. Neilson and J. Snodgrass. Obtaining ammonia in connection with the distillation of oil-yielding or carbonaceous minerals. February 12

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Specifications thus advertised are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

5002 H. Simon and W. Charlton. Improvements in hydraulic mains and valves for conducting gases and other products of distillation from coke-ovens, gas-retorts, gas-producers, etc. February 23

5073 L. Mond. Separation of ammoniacal products and tar from producer or other furnace gases. February 16

12298 H. Stier. Process of extracting from carboniferous materials the products met with, the processes of converting into gases, and of withdrawing gases (for instance, process of distilling, of smouldering, and the like). January 26

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

1636 A. M. Clark, London.—Communicated by the Farbfabrik vormals Branner, Germany, through Wirth & Co., Frankfurt. The manufacture of a new beta-naphtholmonosulpho acid, and products therefrom. February 4

2983 W. R. Lake, London.—Communicated by A. E. Spencer, United States. Improvements relating to blueing for laundry purposes, and to means for facilitating the use of the same. Complete specification. February 12

2213 C. A. Martius, Berlin. Improvements in the production of mixed azo-colours. February 15

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

3889 J. Inray.—Communicated by J. Boasboason. Manufacture of blue and violet colouring matters by oxidation of the thio-bases of diamines. January 29

15775 H. H. Lake.—Communicated by The Schoellkopf Aniline and Chemical Co. Improvements in and relating to colouring matters. January 26

15781 H. H. Lake (The Schoellkopf Aniline and Chemical Co.) Improvements in and relating to colouring matters. January 26

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

APPLICATIONS.

1896 W. R. Lake, London.—Communicated by H. R. Randall, United States. Improvements relating to the treatment of silk cocoons, raw silk, or the like. Complete specification. February 9

2226 J. P. Land and C. P. Ring, London. An improved apparatus for carbonising and destroying vegetable matter in wool. Complete specification. February 16

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

5512 B. Hallett and T. F. Wiley. Method of applying waterproofing material to pile and other goods. February 16

15906 T. F. Wiley. Process of treating textile fabrics to render them waterproof. January 29

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

1121 W. Birch, Manchester. Improved apparatus to be employed in washing, soaping, dyeing, and dunging woven fabrics. Complete specification. February 1

1465 H. Horner, London.—Communicated by C. C. Sabin, Canada. Improvements in and apparatus for blueing water for laundry and other purposes. February 1

1182 J. Coulter, Halifax. Improvements in "hawking" machines for indigo-dyeing. February 2

1577 F. A. Gatty and V. H. Gatty, Manchester. Printing and discharging various colours upon cotton fabrics dyed with a certain dye. February 3

1621 J. Aimers, Galashields. Scouring wool or other fibrous substances. February 4

1627 P. B. Wilson, Glasgow. "Zweimal gedruckt" for printing designs of one or more colours on both sides of the cloth at one operation, and to give exact fitting on cotton, cloth, silk, wool, linen, and paper, or any other material. February 4

1750 W. G. White, London. Improvements in dyeing fabrics, and in apparatus used for that purpose. February 5

2051 R. H. Ainsworth and E. B. Manby, London. Improvements in apparatus for bleaching light and heavy textile fabrics and other materials by the "Thompson" and other analogous processes, which are also applicable for dyeing purposes. February 12

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

1018 L. Mond, London. Improvements in obtaining ammonia and hydrochloric acid from ammonium chloride. January 23

1019 L. Mond, London. Improvements in obtaining ammonia and chlorine from ammonium chloride. Jan. 23

1050 W. Bramley, London. Improvements in the manufacture of carbonates or bicarbonates of sodium or potassium from their sulphates. January 23

1241 A. Fould and P. Genreau, London. Process for obtaining magnesia or mixtures of magnesia and lime suitable for the manufacture of refractory articles and other purposes. January 27

1288 G. Perry, London.—Communicated by M. Perry, New South Wales. Improvements in obtaining compounds of cobalt from solutions containing the same. January 28

1289 G. Perry, London.—Communicated by M. Perry, New South Wales. Improvements in obtaining compounds of cobalt from solutions containing the same. January 28

1831 A. McDonald Graham, London. An improved process for manufacturing sulphates of metals from their oxides. February 8

1832 A. M. Clark, London.—Communicated by O. Eyckens, France. An improved method of producing lead-salts generally, and especially carbonate or oxycarbonate of lead (white lead). February 8

1861 G. H. Nichols, W. H. Nichols, and J. B. F. Herreshoff, London. An improved sulphuric acid tower. Complete specification. February 9

1881 J. J. Hood and A. G. Salamon, London. Improvements in the preparation of aluminium compounds. February 9

1915 J. Mactear, Glasgow.—Communicated by J. Kolb, France. Improvements in obtaining chlorides of barium and strontium. February 10

1989 J. Mactear, Glasgow. Improvements in preparing soda for sale and distribution. February 11

2207 H. J. Leslie, London.—Communicated by R. Finch, Germany. Improvements in the concentration of sulphuric acid, and in apparatus for that purpose. February 15

2233 M. R. Pryor, Stevenage, and A. C. Jameson, London. Improvements in the extraction of nitrate of soda and other salts. Complete specification. February 16

2262 E. Luhmann and C. G. Rommenhöller, London. An improved measuring apparatus for liquid carbonic acid. Complete specification. February 16

2335 H. H. Wilson, London. Improvements in the process and apparatus for the manufacture of anhydrous sulphuric acid. February 17

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

1982 W. L. Wise.—Communicated by R. Radot. Apparatus for decarbonating carbonate of barium and carbonate of strontium. January 29

3933 F. S. Newall. Treatment of alkali-waste to obtain useful products. January 29

1025 J. J. T. Schlesing. Manufacture of carbonate of soda by aid of ammonia. January 26

1274 H. Gaskell, jun. Treatment of bicarbonate of soda for obtaining useful products therefrom. February 19

1285 G. Attwood. Means for the continuous oxidising and desulphurising of ores or minerals. January 26

1902 A. Neilson and J. Snodgrass. Obtaining ammonia in connection with the distillation of oil-yielding or carbonaceous minerals. February 12

8973 L. Mond. Separating ammoniacal products and tar from producer or other furnace gases. February 16

12745 W. R. Lake.—Communicated by T. Schmidtborn and D. Jarves. Manufacture of ammonium chloride and potassium sulphate. February 9

1886.

719 A. Osenbrück. Manufacture of anhydrous ammonia, and utilisation thereof for production of cold or work or both. February 23

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

1089 A. Shaw, Longton, Staff. A novel application of earthenware, china, or fireclay in connection with water-closet cisterns. January 25

1129 H. H. Redfern, Hanley. Improvements in enamel, hardening-on, and other kilns. January 26

1411 J. Haley, Manchester. Glass files, and the process of making the same. February 1

1563 W. Cotterell, Crossmyloof, near Glasgow. Producing metallic designs, etc., on glass, porcelain, earthenware, plastic surfaces, metals, and other materials. February 3

1597 A. Lurashi, London. Improvements in the manufacture of articles of glass, and means or apparatus employed therein. February 3

2073 G. Lazenby, London. Improvements in kilns, such kilns being applicable for bending glass, firing stained glass, tiles, potteryware, and for other purposes. February 12

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

3115 G. J. Atkins. Process for decoration and treatment of glass, porcelain, metal, etc. February 23

5012 R. Clark. Machinery for battening potters' clay. Feb. 5

5020 T. Walton. Manufacture of tumblers and other articles of glass, and apparatus or machinery therefor. February 9

5130 H. Codd. Manufacture of glass bottles. February 19

1886.

70 C. D. Abel.—Communicated by F. C. Glaser. Preparation and application of drawings and pictures to earthenware articles, and other ceramic products. February 16

805 W. Jakes and W. J. Kershaw. Ornamentation of glass articles and sheet or plate glass. February 19

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

- 1126 C. D. Alison, London. Improvements in the manufacture of cements and plasters. January 26
 1130 W. Johnson, Leeds. Improvements in the manufacture of sand-faced bricks, and in apparatus used therefor, part of such apparatus being also applicable in the manufacture of other than sand-faced bricks. January 26
 1163 H. R. Vaughan, Liverpool. Improvements in drying floors or plant for drying bricks and other like articles. January 26
 1191 R. Jenkins and J. Cox, Bexley Heath. Improvements in enamelled coloured plaster for walls and other objects. February 2
 1694 E. Ashby and A. Ashby, London. An improvement in cement kilns. Complete specification. February 3
 1642 O. Brach, Liverpool. A new or improved plastic composition applicable for use for absorbent purposes and for the manufacture of pipe bowls and the like. February 4
 1765 J. Chapman, Milverton, Somersetshire. Weather-proof tile. February 6
 1816 W. Joy, London. Improvements in the method of charging cement kilns and apparatus to be used therein. February 8
 1836 J. B. White, jun., London. Improvements in the manufacture of Portland cement. February 8
 2566 P. Bawden, London. Improvements in machinery for the manufacture of bricks and tiles. February 22

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 2806 J. Cawley. Mineral amalgam or cement. January 29
 3897 J. H. Johnson—Communicated by J. Brandstatter. Manufacture of artificial stone. February 9
 5189 A. W. Lake—Communicated by T. Hyatt. Improvements in concrete lights. January 29
 5213 T. C. Fawcett and J. D. Fawcett. Machinery for pressing bricks, brickettes, tiles, etc. February 23
 5142 F. Ransome. Manufacture of Cement. February 16
 9151 W. Joy. Manufacture of cement. January 26

X.—METALLURGY, MINING, ETC.

APPLICATIONS.

- 1027 T. J. Greenway, Sheffield. Improvements in separating the precious metals from lead. January 23
 1040 E. Morewood, Llanelli. Improvements in coating with tin or other coating metal, sheets, plates, or pieces of iron or other metal. January 23
 1102 W. Tooth, London. An improved method of and means for extracting spelter, and in apparatus therefor, and for treating the waste products. January 25
 1342 A. K. Huntington, London. A method of annealing or tempering metallic wire or ribbon. January 29
 1140 P. Adie, Westminster. Improvements in tempering Steel. February 1
 1170 H. H. Lake, London—Communicated by La Société de Laminage du Nickel, France. Improvements relating to the recovery of Nickel from scraps of metal plated or coated therewith, chiefly designed for the manufacture of anodes for use in electro-plating. February 1
 1173 H. H. Lake, London—Communicated by La Société de Laminage du Nickel, France. Improvements relating to the covering or coating of metal with nickel or alloys thereof. February 1
 1796 T. Twynam, London. Improvements in the purification of iron and of phosphatic ferruginous slags. Feb. 6
 1827 G. A. Goodwin and W. F. How, London. Improvements in foundry ladles and crucibles. February 8
 1872 A. J. Boulton, London—Communicated by L. W. Sinsabaugh, United States. Method of reducing steel railroad rails to plate metal. Complete specification. Feb. 9
 1892 L. Grabau, London. Improvements relating to the extraction of metals from substances containing the same, by electrolysis, and to apparatus therefor. February 9
 1961 E. P. Vershave, E. C. F. Vershave, and A. F. V. M. Baron, London. Improvements in the manufacture of bronze and other alloys. February 10
 2274 H. R. Cassel, London. An improved process for coating or plating iron or steel. February 16
 2276 A. Eckardt, London. Improvements relating to the coating of metals with lead, tin, or zinc, or with alloys of these metals, and to apparatus therefor. February 16
 2402 H. H. Lake, London—Communicated by The Verein Chemischer Fabriken, Germany. Improvements relating to the recovery of tin from scraps of tinned plate. February 18
 2415 W. Thomlinson, London. The preparation of finely divided metalliferous substances for reduction or smelting. February 19
 2557 T. Fenwick, London. Improvements in electro-depositing zinc upon iron and other metals. February 22

2560 A. T. Davies, T. H. Griffiths, and D. Griffiths, London. Improvements in the manufacture of tin and other coated metal plates, and in apparatus employed therein. Feb. 22

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 3721 W. H. Tooth and J. E. Rooker. Furnaces and apparatus employed in the manufacture and refining of iron, and the conversion of iron into steel. February 9
 3738 E. Morewood. Coating with tin,terne, or other coating metal, sheets, plates, or pieces of iron or other metal. Feb. 12
 4228 T. Bayley. Manufacturing oxide of iron and obtaining other useful products. February 12
 4478 W. E. A. Hartmann. Treating waste liquors from the manufacture of tin plates. February 23
 4581 T. Minnis and E. Ingram. Improvements in and connected with galvanising baths. January 26
 4925 L. Roberts, D. Roberts, and J. Colquhoun. Furnaces and appliances for smelting, puddling, refining, heating, or otherwise treating minerals, metals, etc. February 2
 8118 J. Y. Johnson—Communicated by E. Deligny. Process for purifying copper precipitates. February 23
 10621 J. Dixon, P. J. Blades, W. S. Douglas, D. Garlick, and W. Malcolm. Improvements in process of smelting pyrites and in the tuyeres of blast furnaces used therefor; also method and apparatus for feeding such furnaces. January 26

XI.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

- 1026 R. Hutchinson, Glasgow. Improvements in the manufacture of lubricants. January 23
 1113 R. Park and J. E. Park, Glasgow. Improvements in the manufacture of soap. January 25
 1525 C. Fink, London. Improvements in lubricating compounds. Complete specification. February 2
 1930 A. C. Henderson, London—Communicated by M^{me}. Bandot, France. An improved process and treatment of fatty matters and fatty acids for use in the manufacture of stearic acid candles, which improvements render such matters applicable for other uses. February 10
 1939 J. Whittle, London. Improvements in and apparatus for extracting or separating oil or grease from cotton waste and similar materials. Complete specification. February 10
 2178 J. Dewrance, London. Lubricants for steam cylinders. February 15
 2241 H. F. Ihlee, London—Communicated by W. Benger & Sons, Germany. A new or improved manufacture of soap. February 16
 2177 T. Harrison, Arnside. Testing the lubricating power of oils called "lubricating oil tester." February 20

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 3441 C. R. Huxley. Ammoniated soaps, free from oleates, and compounded to dispense with the destructive friction of the brush. February 5
 5382 A. G. Brookes—Communicated by R. Giebertmann. Distillation of glycerine, and means or apparatus employed therein. February 2
 5998 M. S. Gosling. Soap paste for cleansing woollen and other kindred fabrics. February 23

XII.—PAINTS, VARNISHES, AND RESINS.

APPLICATIONS.

- 1086 F. Wendling, London. Improvements in the manufacture of paint. January 25
 1511 E. W. McClave, London. Apparatus for distilling turpentine, and for the purification of the crude products of the distillation thereof. Complete specification. February 2
 1832 A. M. Clark, London—Communicated by O. Eyckens, France. An improved method of producing lead salts generally, and especially carbonate or oxy-carbonate of lead (whitelead). February 8
 2110 D. Swan, Glasgow. Improvements in obtaining pigments. February 17
 2482 W. Crow and W. Coley, Birmingham. A compound for coating metals, wood, stone, and other materials. February 20
 2530 W. Welch, Portsmouth. Improvements in hydraulic cements for coating iron and steel ships, vessels, buildings, and other surfaces. February 22

COMPLETE SPECIFICATION ACCEPTED.

1885.

- 3839 E. V. Gardner. Manufacture of whitelead, and apparatus employed therefor. January 26

XIII.—TANNING, LEATHER, GLUE AND SIZE.

APPLICATION.

- 2052 W. R. Earp, Liverpool. Improvements in the manufacture of leather. February 12

XIV.—AGRICULTURE, MANURES, Etc.

APPLICATIONS.

2298 A. C. Smethwick, Manchester. An improved method of and means for pressing and preserving grass and other vegetable substances. February 17

COMPLETE SPECIFICATION ACCEPTED.

1885.

4718 T. H. Selater. Combined insect destroyer and soil fertiliser. February 9

XV.—SUGAR, STARCHES, GUMS, Etc.

APPLICATIONS.

1108 A. M. Clark, London—Communicated by Wirth & Co., for J. J. Hang and C. Hoffmann, Russia. The manufacture of a substitute for caoutchouc and gutta-percha. Complete specification. January 25

1820 L. Cuisinier, Liverpool. A new or improved diastasic saccharine substance, and method of manufacturing the same. February 8

1888 W. R. Lake, London—Communicated by F. O. Matthiessen, United States. Improvements relating to filters, and apparatus connected therewith, for purifying sugar-liquor. Complete specification. February 9

1889 W. R. Lake (F. O. Matthiessen). Improvements in and relating to discharges for filtering apparatus to be used in the purification of sugar-liquor. Complete specification. February 9

1890 W. R. Lake—Communicated by E. E. Quimby, United States. Improvements in filtering apparatus for purifying sugar-liquor. Complete specification. February 9

1891 W. R. Lake—Communicated by R. C. Howes, United States. Improvements in filtering apparatus for use in the purification of sugar-liquor. Complete specification. February 9

1914 J. McClure C. Paton, London. Improvements in or connected with triple effect evaporating apparatus used in the manufacture of sugar. Complete specification. February 10

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

4758 B. H. Remmers—Communicated by L. von Wagner and A. Gillitzer. Manufacture of starch, and apparatus therefor. February 19

7914 F. Wilhöft. Vulcanised soft rubber, and process of making the same. February 16

11618 W. Thompson, J. Mylne, and J. B. Allott. Apparatus for the expression of juice from the sugar-cane. February 2

15530 L. Sternberg. Extracting sugar from saccharine fluids. January 29

1886.

508 W. R. Lake—Communicated by W. T. Jebb. Manufacture of starch. February 12

XVI.—BREWING, WINES, SPIRITS, Etc.

APPLICATIONS.

1222 E. R. Southby, London. Improvements in treating malt extracts. January 27

1293 C. J. Pickthall, London. Improvements in linings for malt and other fermented liquors. January 28

1157 A. S. Tomkins and F. A. Cracknall, London. Improvements in apparatus for heating kilns for drying malt, grain, and other materials. February 1

1858 W. Palethorp, Newcastle-on-Tyne. Improvements in regulating and aerating worts and beers in brewing. February 9

1893 J. Mercer, London—Communicated by C. C. Beers, United States. Improvements relating to the purifying and maturing of spirituous and other liquors, and to apparatus therefor. February 9

2071 J. Smolik, London. Improvements in the construction of malt kilns, and in the method of and apparatus for drying malt. February 12

2107 F. Faulkner and W. Adlam, London. Improvements in apparatus for restricting or controlling convection or circulation of vesicles of vapour in heating or boiling wort in brewers' coppers, and in analogous processes. February 13

2108 F. Faulkner and W. Adlam, London. Improvements in the method of obtaining hop extract in the process of brewing beer, porter and other like liquors, and in apparatus therefor. February 13

2237 T. Bowen, London. An improved method of preserving alcoholic liquids, such as ale, porter, and the like. February 16

2316 F. Faulkner, Oldbury. Improved means of filtering cooler wort for determining rapid clarification of finished beer, and in arrangement of apparatus for the purpose. February 17

COMPLETE SPECIFICATION ACCEPTED.

1885.

4068 W. Lawrence. Manufacture of beer and malt liquors, and apparatus for treatment and preparation of materials for the same. February 9

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

APPLICATIONS.

A.—CHEMISTRY OF FOODS.

1330 W. McDonnell, London. Improvements in the preservation of milk or cream, and in the manufacture of butter therefrom. January 29

1442 W. A. Murray, London. Improvements in the manufacture of butter. Complete specification. February 1

2144 B. M. Plumb and T. J. Richman, London. A process for extracting butter from milk, and for manufacturing butter. February 13

2191 W. McDonnell, London. Improvements in the means of preserving alimentary substances. February 15

2501 D. Johnson and H. G. R. Davies, London. Improvements in the means or apparatus for use in storing or preserving vegetable matters to be used as food. February 20

B.—SANITARY CHEMISTRY.

1053 G. H. Leame, London. An improved method of continuous filtration, applicable to the purification of sewage, and for other purposes. Complete specification. January 23

1076 H. Fewson, Buckingham. The treatment of mephitic vapours and noxious gases generally, but especially for the compound gases known as "sewer gas." January 25

1259 S. D. Cox and J. Cox, Bexley Heath. Improvements in the treatment of sewage. January 28

1727 W. H. Hartland, Glasgow. Improvements in purifying sewage and treating the same for the recovery of products therefrom, and in means or apparatus therefor. February 5

1792 F. Candy, London. Improvements in the preparation of materials suitable for use in the treatment of sewage and for other purposes. February 6

1793 F. Candy, London. Improvements in the manufacture of filtering media for use in the purification of liquids and gases. February 6

1840 W. Davis, Plaistow. Treating sewage by using sulphuric acid, lime, charcoal, and vacuum. February 9

2086 P. A. Maignon, London. An improved process for the softening and purification of liquids and the construction of apparatus used therewith. February 12

2175 A. M. Clark, London—Communicated by L. E. Robert, France. Improvements in filtering and purifying water. February 15

2139 F. H. Daneshell, London. A new or improved system of treatment of sewage. February 19

2517 F. Candy, London. Improvements in the manufacture of filtering materials and precipitants. February 20

C.—DISINFECTANTS.

2506 F. Hochuli, London—Communicated by E. Pollacsek and J. Elsner, France. An improved disinfecting soap. February 20

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

B.—SANITARY CHEMISTRY.

1891 J. Richmond and T. Birtwistle. Improvements in furnaces for treating town and other refuse. January 29

1473 E. Langen. Method and apparatus for treating semi-liquid substances with purifying or other liquids. February 12

4332 J. W. Slater. Treatment of sewage and water polluted with organic matter. January 26

4711 H. J. Haddan—Communicated by G. Langbein. A method of disinfecting. February 16

5348 M. Nahnsen. Purifying drainage waters and sewage. February 9

6054 F. Maxwell-Lyte. Improvements in sewage purification process and those of other foul waters. February 19

XVIII.—ELECTRO-CHEMISTRY.

APPLICATIONS.

1011 A. Rettich, London. Improved construction or arrangement of dry electric battery, with regenerative and self-sustaining power. January 22

1051 J. H. Nond, London. An improved construction or formation of plates with composition for electric batteries. January 23

1150 T. J. Handford, London—Communicated by F. J. Sprague, United States. Improvements in and relating to electro-dynamic motors. January 26

1151 W. W. Popplewell, London—Communicated by F. La Otis Lathrop, J. W. Carter, and C. Fabre, United States. Improvements in galvanic batteries. Complete specification. January 26

1169 W. P. Thompson, Liverpool—Communicated by A. H. Cowles, United States. Improvements in smelting ores by means of electricity, and in apparatus or furnaces therefor. Complete specification. January 26

1161 W. P. Thompson, Liverpool—Communicated by E. H. Cowles and A. H. Cowles. A new or improved lining for the walls of electric furnaces. Complete specification. January 26

1340 G. C. Fricker, Putney. Improvements in dynamo-electric machines. January 29

1354 H. J. Allison, London—Communicated by E. M. Gardner, United States. An improved electrode for secondary batteries. Complete specification. January 30

1375 R. M. Bailey, jun., and A. Grundy, London. Improvements in galvanic batteries. January 30

1415 N. J. Contarini and T. Wrigley, London. Improvements in the construction of primary and secondary electric batteries. February 1

1493 H. J. Allison, London—Communicated by L. Voelker, United States. Improvements in dynamic-electric machines and motors. Complete specification. February 2

1513 G. Ignatief, London. Improvements in electric candles. February 2

1684 B. Weise, London. Improvements in secondary electric batteries. February 4

1892 L. Graban, London. Improvements relating to the extraction of metals from substances containing the same, by electrolysis, and to apparatus therefor. February 9

2103 H. J. Haddon, London—Communicated by E. H. Cowles and A. H. Cowles, United States. Improvements for operating electric smelting furnaces. Complete specification. February 18

2133 T. A. Garrett, London. Improvements in and connected with dynamo-electric machines or motors. February 19

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

3467 A. M. Clark—Communicated by L. Vissière. Dynamo-electric machines. February 9

3524 T. J. Handford—Communicated by F. J. Sprague. Improvements in electric dynamic motors, parts of which improvements are applicable to the regulation of dynamo-electric generators. February 12

3599 A. Reckenzaun. Electro-motors or dynamo-electric machines. January 26

3761 J. Macnab and D. Hickie. Electric fuses. February 23

3815 H. Woodward. Thermo-electric generators and insulating materials. February 12

4127 J. S. Williams. Transforming, distributing, controlling and utilising electric and magnetic force; and apparatus or means employed therefor or in combination therewith. February 19

5202 A. Sebanschiff. Galvanic batteries. February 19

5828 B. J. B. Mills—Communicated by J. J. C. Smith. Mode of vulcanising the insulating covering of electrical conductors. February 16

7461 A. R. Upward and C. W. Pridham. Galvanic batteries. February 23

XIX.—PAPER, PASTEBOARD, ETC.

APPLICATIONS.

1061 G. F. Redfern, London—Communicated by J. Ubertin, Corsica. An improved liquid or lye to be employed in the manufacture of paper. January 13

1178 J. H. Oberhaeush, London. Improvements in the manufacture or treatment of paper for drawing or writing upon. January 26

1795 J. T. McDougall and J. McDougall, London. Improvements in extracting moisture from pulp produced from wood or other fibrous materials. February 6

2221 T. Rowland, Halifax. Improvements in apparatus for pulping fibres for the manufacture of paper. February 16

2278 H. H. Lake, London—Communicated by C. E. Ball, United States. Improvements in boilers or digesters for use in the manufacture of paper pulp. Complete specification. February 16

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

3921 G. P. Barnes. Manufacture of paper and machinery therefor. February 2

4300 W. P. Bruce. Dividing paper as it is being formed into a continuous length on a paper-making machine into two or more narrow lengths. February 16

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

APPLICATIONS.

1197 T. C. Lovewell, Brighton. Lovewell's Mitcham lavender smelling salts. February 2

1551 O. Inray, London—Communicated by J. G. Smith, Hong-Kong. The manufacture from fresh green ginger of dried ground ginger, crushed ginger, ginger paste, flour of ginger, essential oil of ginger, and essence of ginger. February 2

COMPLETE SPECIFICATION ACCEPTED.

1885.

4669 W. V. Wilson. Manufacture of acetate of amyl. February 16

XXI.—EXPLOSIVES, MATCHES, ETC.

APPLICATIONS.

1082 G. V. Jameson, London. A safety explosive, to be designated: "The Victoria Safety Explosive." January 25

1920 T. G. Hart, Bath. Improvements in explosives for use in firearms. February 10

1921 T. G. Hart, Bath. Improvements in explosives for use in firearms. February 10

1955 F. Bolton, London. An improved manufacture of explosive compound, and the preparation of cartridges therefrom. February 10

2088 S. H. Emmens and J. O. Bryne, London. An improved explosive compound and a method of using the same. Feb. 12

2187 G. F. Redfern, London—Communicated by O. Hiernaux, Belgium. The manufacture of an improved explosive compound. February 15

COMPLETE SPECIFICATION ACCEPTED.

1885.

15528 C. E. Bichel. Improvements in explosive compounds. February 2

XXII.—GENERAL ANALYTICAL CHEMISTRY.

APPLICATION.

1938 T. Derham, London. Certain improvements in hydrometers and saccharometers. February 10

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E. J. Bevan.	A. J. King, B.Sc.
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T. L. Briggs.	F. Machenhauer.
C. Clans.	Wm. Macnab, Jun.
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Julius B. Cohen, Ph.D.	G. Harris Morris, Ph.D.
C. F. Cross.	J. M. H. Munro, D.Sc.
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A. G. Green.	F. W. Renault.
S. Hamburger, Ph.D.	Samuel Rideal.
J. H. Hodgkinson.	James Taylor, B.Sc.
James Hulme.	F. L. Teed, D.Sc.
J. J. Hummel.	V. H. Veley, M.A.
Bertram Hunt.	Alex. Watt.
C. C. Hutchinson.	Sydney Young, D.Sc.

NOTICE.

The supply of copies of the Journal for January, 1882, being now exhausted, the Secretary would be glad to receive communications from members possessing extra copies of that number, in good condition, with a view to purchase.

Should sufficient applications for complete sets be received, the number will be reprinted.

CHANGES OF ADDRESS.

F. T. Addyman, 10 Nottingham; Laboratory of Royal Agricultural Society of England, 12, Hanover Square, London, W.

J. O. Alexander, 10 Demerara; 1, Belhaven Terrace, Kelvin-side, Glasgow.

Geo. Archbold, 10 Oswego City; Laboratory, Phoenix, Oswego Co., N.Y., U.S.A.

E. J. Bevan, 10 High Holborn; 1, New Court, Lincoln's Inn, W.C.

Robert Bourcart, 10 Geneva; 18, Chaussée de Dornach, Mulhouse, Alsace.

A. Campbell, 10 Southampton; 19, Harold Road, Upton Park, Essex.

Jas. Charlton, 10 Clayton; Ellesmere Park, Eccles, near Manchester.

C. F. Cross, 10 High Holborn; 1, New Court, Lincoln's Inn, and Eaton Terrace, as before.

James Duncan, 10 Cromwell Road; 9, Mincing Lane, E.C., and Clyde Wharf, Victoria Docks, E.

Geo. Dyson, 10 Sockburn; Hurworth, Darlington.

Jos. Hartley, 10 West Gorton; 6, North Road, Longsight, Manchester.

S. Horrocks, 10 Prince's Street; 38, Duke Street, Southport, Lancashire.

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C. M. King, 10 Hornsey; Inveresk Mills, Musselburgh, N.B.

Walter King, 10 New Malden; Tamworth House, Mitcham, and 110, Cannon Street, London, E.C.

J. G. Lorrain, 10 Southampton Row; Norfolk House, Norfolk Street, Strand, W.C.

E. P. Potter, 10 High Bank; Hollinhurst, Bolton-le-Moors.

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W. L. Bowland, 10 Chancellor Place; 1800, Chester Avenue, Philadelphia, Pa., U.S.A.

A. G. Salamon, 10 Clapham Park; 1, Fenchurch Avenue, London, E.C.

W. J. Taylor, 10 Greenock; c/o L. Briant, 38, Gracechurch Street, London, E.C.

P. H. Walsh, 10 Weston; 13, Penny Street, Blackburn, Lancashire.

W. J. Williams, 10 Philadelphia; 521, North 3rd Street, Camden, N.J., U.S.A.

Death.

H. Sugden Evans, 10 Ottawa, Canada, at New York—February 23.

ERRATUM.

Mr. J. B. Hutcheson's name was improperly spelt "Hutchinson" in the List of Members.

LIST OF MEMBERS ELECTED 23rd MARCH, 1886.

W. B. Allbright, Boston Street, Dorchester, Mass., U.S.A., oils chemist.

Herbert A. Bainbridge, Union Club, Trafalgar Square, S.W., brewer.

C. H. Bedingfield, 4, Tichborne Street, High Fields, Leicester, traveller.

J. Ferguson Bell, C.E., Stafford, gas engineer.

W. E. Benton, Littleworth House, Hednesford, Staffordshire, lecturer on mining.

Arthur E. Brown, Morden Cliff, Lewisham, S.E.

A. S. Bryce, Glenpark Oil Works, East Nelson Street, Glasgow, oil refiner.

A. S. Bryce, jun., 8, Broompark Terrace, Dennistoun, Glasgow, oil merchant.

Carl F. Claus, jun., Iceland Wharf, Old Ford, E., chemist.

G. A. Clowes, Needham Market, Suffolk, brewer and maltster.

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R. Steele Fletcher, Misterton, Gainsbro', Lincolnshire, analyst.

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Jno. Gray, Pentland Oil Works, Loanhead, Midlothian, chemist.

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Jno. Jackson, 260, Dobbie's Loan, Glasgow, lubricating oil manufacturer.

F. H. Leeds, 14, Bouverie Road, Stoke Newington, N., consulting chemist.

J. G. MacArthur, 260, Dobbie's Loan, Glasgow, lubricating oil manufacturer.

R. H. M. Murdoch, 1, Nobel's Villas, Stevenston, Ayrshire, analyst.

Wm. Oldershaw, 69, Long Row, Nottingham, chemist.

Wm. Pearson, 20, Mellor's Buildings, Exchange Street E., Liverpool, seed crusher.

W. G. Reid, Young's Oil Co., Limited, Uphall, N.B., analyst.

C. J. Shackleton, Sydney Villa, Mill Hill, Derby; and Phoenix Chemical Works, Ironbridge, Salop, chemical manufacturer.

Masachika Shimose, M.E., Insatsu Kyoku, Tokyo, Japan, chemist (note Printing Department).

R. W. Smith, The Grange, Kirkburton, near Huddersfield, manufacturing chemist.

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G. Crosland Taylor, Thornton Hough, near Neston, Cheshire, electrician.

Chas. F. Thatcher, Gwydyr House, 559, Old Kent Road, S.E., brewer.

Walter H. Thew, 47, Castle Street, Liverpool, provision merchant.

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London Section.

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Local Sec. and Treasurer: Thos. Tyrer,
Garden Wharf, Church Road, Battersea, S.W.

MEETINGS, SESSION 1885-86.—First Monday in each month (unless otherwise indicated).

ORDINARY MEETINGS.

First Monday in the Month, at 8 p.m.

April 5.—Professor Unwin, M.I.C.E.—"The Principles and Methods of Testing Cementing Materials." This meeting will be held in the Central Institute, City and Guilds of London Institute, Exhibition Road, South Kensington.

May 3.—A. G. Salamon, A.R.S.M., F.C.S., and W. de Vere Milnew, F.I.C.—"The Purification of Water." Messrs. Macnab and Beckett—"The Treatment of Water for Technical Purposes."

June 7.—Dr. Meymott Tidy—"Chemical Treatment of Sewage."

July.—Annual Meeting at Liverpool.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held Monday, February 1, 1886.

MR. D. HOWARD IN THE CHAIR.

NOTES ON DR. KOCH'S WATER TEST.

BY GUSTAV BISCHOF, F.C.S., F.I.C.

THE task before me this evening has been rendered comparatively easy by Dr. P. Frankland's instructive paper, read before this Section last year,* to which I am sure you listened with as much interest as I did. Fortunately, the original intention of letting my paper precede Dr. Frankland's on the same evening was, at my suggestion, abandoned, enabling me to considerably shorten my observations on the present occasion. To prevent repetitions you will please understand that in giving the outlines of Dr. Koch's test, I adhere to Dr. Frankland's description, unless otherwise stated.

PREPARATION OF NUTRITIVE GELATINE.

Dr. Koch adds 5grms. of common salt, not 1grm. to the extract from 1lb. of beef, and mixes 100grms. of gelatine with the same quantity. I have adopted these proportions, and find no difficulty in working them. As it is a matter of some moment that the gelatine should be heated as little as possible, Dr. Frankland would perhaps tell us whether he has increased the steaming of the nutritive gelatine in test-tubes to half-an-hour on each of three consecutive days, because he found Dr. Koch's time, a quarter of an hour, insufficient. No other way is as sure to sterilise test-tubes as heat; and I prefer Dr. Koch's rule of exposing them, after cleansing and plugging, for one hour to a temperature of 150° to 180° C.

STERILISATION OF BOTTLES, PIPETTES, ETC.

Dr. Frankland continues the heating of the bottles, pipettes, etc., in an air bath, to 150° to 180° C., for at least three hours. Dr. Koch's and my experience is that one hour is sufficient, counting from the moment when the thermometer in the air bath reaches 150° C. I thought at one time that this might not be so when sterilising glass plates in a metal box, but that certain minute colonies, which I observed in some cases, might be due to imperfect sterilisation of the plates. To test this a thermometer was introduced during sterilisation into the centre of the plates, and it only indicated 100° C., when the air in the bath showed 150°; the former thermometer, indeed, did not reach 150° until the heating had been continued for another 165 minutes. The glass plates were numbered several times, when sterilised in the usual way, so that those might be known which had been in the centre; but in no case could I trace a result to their imperfect sterilisation after one hour's heating.

COLLECTION OF SAMPLES OF WATER.

For plugging flasks, test-tubes, and the like, asbestos thread has, in my opinion, advantages over the time-honoured cotton-wool. The shrinking of cotton-wool stoppers on heating sometimes causes them to become dangerously loose, however tight they may have been before. The asbestos may be heated, boiled or treated with acids to any extent; and should a plug during an experiment be accidentally dropped, it is instantly rendered serviceable by holding it for a moment into a Bunsen flame. The disagreeable sticking of cotton-wool, if any of the size used in its preparation touches the side of the test-tube, etc., is avoided by the use of asbestos. As regards exclusion of microphytes,

* See ante, p. 81.

asbestos plugs are quite equal to the other, and if cuttings from asbestos cloth be unravelled, the cost is only nominal.

I have devised flasks for transport provided with an asbestos plug, as well as a glass stopper. They are Erlenmeyer's flasks (Fig. 1) with elongated necks, which are slightly contracted near their base. Into this part a glass stopper is carefully ground; the stem reaches beyond the top of the flask, and is surrounded by the asbestos plug. During sterilisation the glass stopper should not be quite closed, or the flasks are apt to fly.

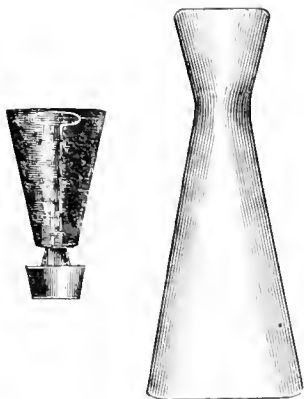


FIG. 1.

The samples of water are filled into these flasks by means of a sterilised pipette, which is enclosed during transport in an outer plugged glass tube. The pipette is immersed into the water to be tested, or, when this is not practicable, the sample is received in the first instance in a small sterilised and plugged phial provided with a lip. The phials have not a flattened rim, and before allowing the water to run in, the top is wiped with the lower sterilised part of the plug. In either case, we are thus enabled to avoid wetting the upper part of the flask, and the flushing into its interior of any impurity which may adhere to the rim.

I have made several experiments with reference to the liability of samples of water to alter if kept after collection. Table I. shows two sets, A and B, in which New River water, with or without the addition of one per cent. of sewage, was kept and tested during six days. In all my experiments the sewage was filtered through paper before being added. Each of the samples was received in a separate plugged flask, until required for use. Samples A were kept at the ordinary temperature of my laboratory, from the 14th of November last, the others in an air bath between 14° and 17° C. The New River water A shows an enormous increase from day to day, amounting in the end to 14,500 times the original number of colonies. The test on the fourth day was lost, all the colonies having run into each other. Subsequently the quantity taken in testing was reduced. The entirely different behaviour of samples A with sewage is remarkable. The latter evidently set up a kind of violent fermentation, which, culminating on the second day, when the limited quantity of food present was probably exhausted, was followed by a gradual regular decrease of the total colonies, until they were on the sixth day practically the same in number as on starting, the liquefying colonies being finally about one-third, and the total colonies one-nineteenth of those in the unadulterated sample of New River water.

Experiments B were made with another set of

materials, differing probably in the food or phosphoric acid they contained, or the microphytes present. All intermediate samples were lost through the colonies running into each other. The liquefying colonies in the New River water again multiplied enormously—viz., 1600 times, against 80 times in the mixture with sewage. The total colonies increased in the New River water about 1000 times; but in the sample containing sewage only about 2½ times.

TABLE I.—COLONIES FOUND IN NEW RIVER WATER KEPT FOR SIX DAYS.

DAY.	Liquefying Colonies.	Total Colonies.	Do. after adding 1% Sewage.		
			Liquefying Colonies.	Total Colonies.	
A	1..	1	53	14	31,000
	2..	1	2,200	210	120,000
	3..	100	260,000	210	93,000
	4..	—	—	210	62,000
	5..	88	120,000	210	47,000
	6..	610	770,000	210	40,000
B	1..	5	142	178	500,000
	6..	8,000	140,000	14,000	1,300,000

EXAMINATION OF SAMPLES.

The apparatus devised by Dr. Koch for spreading the mixture of water and nutritive gelatine on a glass plate is represented by Fig. 2. The inner one of two glass dishes is completely filled with water and ice,

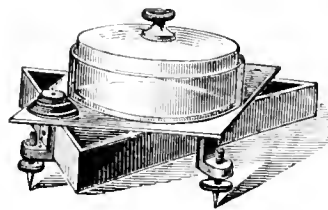


FIG. 2.

when a glass plate, ground on its lower side, is pushed over the inner dish. The dishes rest on a tripod with levelling screws. A bell-shaped cover on the top completes the arrangement. The glass plate which is to receive the gelatine is taken out of the metal box, in which it has been sterilised, and reversed on to the glass plate on the top of the inner dish under the bell-shaped cover. After melting the gelatine, the plug of the test-tube is removed and a proper quantity of water to be tested introduced, avoiding, as far as possible, a vertical position of the tube. The plug is temporarily replaced, whilst water and gelatine are being mixed: it is then taken out once more, and the open end of the test-tube passed through a Bunsen flame to destroy germs which may adhere to it. Finally, the bell-shaped cover is raised just enough to allow the mixture to be spread on the glass plate, where it sets in about a minute. As the area has to be measured if the colonies are too numerous to be counted all over, the gelatine should be spread in the form of a rectangle. This is facilitated by the use of glass plates with a projecting rectangle of enamel of uniform area, which should contain 80 square centimetres when 10cc. of gelatine are used. The rim of enamel prevents the running of the gelatine should the temperature during incubation rise

somewhat high. I prefer 10 to 7cc. of gelatine, on account of the larger area, which not unfrequently allows exact counting of the colonies, when they would have been too close on the smaller area.

The damp chamber used by Dr. Koch is shown in Dr. Frankland's paper, and may be obtained in Berlin for 2s. A few experiments with a 2 per cent. corrosive sublimate seal and 150 instead of 100grms. gelatine, cultivated at 25° C., showed no practical difference in the results as compared with Dr. Koch's method. The latter appears to me more convenient, because the evaporation and condensation in the other case are somewhat excessive, and may give trouble. Even with Dr. Koch's plan, it happened in a few instances that a drop of condensed moisture fell into the sample, which, of course, had to be rejected. On this account, I now cover the plate or plates with a small curved glass plate.

The damp chambers are kept at about 18° C. in a wooden air-bath, through which passes a vertical glass tube, open top and bottom, heated from underneath by means of a small Argand burner and regulator. Unless the colonies threaten to run into each other before that time, I always leave samples in the air-bath for three days. The results of samples which are incubated for a shorter or longer time cannot be strictly compared.

When counting the colonies, the incubated sample is placed on the top of a glass plate divided into square centimetres, and partially into one-ninth part of a square centimetre, resting on a dark surface. Another plate, larger than the gelatin plate, is so arranged on a hinge that it protects the latter against dust without touching it. By this arrangement one's breath is not directed on to the gelatine, otherwise spores of *Penicillium glaucum*, and perhaps other colonies, are apt to be disseminated by the breathing, contaminating the air of the laboratory. Very many colonies are counted in a number of the smaller squares, their average being calculated on the entire area of gelatine. In the same way the larger squares are made use of with few colonies; or, indeed, the colonies are counted all over the plate. A lens sliding on the top of the hinged glass plate assists in the discovery of smaller colonies. Similarly, the liquefying colonies are counted over the whole or part of the plate, the latter being held at a certain angle towards the eye over a dark surface. This divides the colonies, as a beginning, into two classes; but it must be remembered that there are slowly and rapidly liquefying colonies, some, indeed, so slow in their action that they are not recognised as such after the normal time of incubation.

It is not an uncommon error to suppose that all the microphytes contained in a sample of water develop by the culture as described. This is not so. Microphytes, which are strictly parasitic, and thrive only in the living tissue, cannot be developed. Some microphytes have to be cultivated in blood-serum or other media.

IS DR. KOCH'S TEST A QUANTITATIVE METHOD?

I now pass over to the question whether, and how far, Dr. Koch's test can lay claim to be a quantitative method. I attempted to answer this in the first instance by mixing different proportions of a sample of sewage with a comparatively pure water. However, even very small quantities of sewage render the counting of the colonies frequently difficult or impossible, whilst a single drop cannot be measured with precision, nor can we invariably rely upon its being a representative sample. Experiments with larger quantities of water, on the other hand, require very careful handling if contamination foreign to the

sewage is to be excluded; but with this restriction they give more reliable results. Again, what we have to test is unfortunately not matter in solution, but in suspension, and chemists know how difficult it is to take strictly representative samples of matter in suspension.

I submit that the figures in Table II. show the test to be sufficiently quantitative for practical purposes, at least as regards the total colonies.

TABLE II.

Added to 1cc. of New River water drops of a mixture of 99 parts of New River water and 1 part of a sample of old sewage.		COLONIES FOUND.	
		Liquefying.	Total.
1	.. ..	2	590
2	.. ..	10	1,800
3	.. ..	9	3,100
4	.. ..	13	3,400
5	.. ..	18	4,100
Do. of fresh sewage—			
1	.. ..	35	3,500
2	.. ..	50	5,600
3	.. ..	50	8,400
4	.. ..	50	10,000
5	.. ..	56	12,000

The liquefying colonies are less satisfactory; but we are not dealing—as mostly in analytical chemistry—with matter unalterable in quantity. Our matter is capable of self-multiplication; and, further, amongst microphytes, the same fight is going on for supremacy or existence which we find amongst the highest of animals. Dr. Koch considers it possible that bacteria of putrefaction may succeed in exterminating the *Comma bacillus*, whilst Professor Arnaldo Cantani has furnished the following instance:—A patient with a large tubercular cavity in the upper lobe of the left lung was admitted to a hospital on the 26th of April, and improved so rapidly by inhalation of a rich culture of *Bacterium termo* in gelatine, that all the symptoms had disappeared on the 1st of June of the same year, without returning. Before the treatment animals became tuberculous when inoculated with the sputum, but after it this ceased to be. Although we must wait for confirmation of such isolated cases, they show, at any rate, that the fight I have referred to is no novelty to bacteriologists. Depending upon circumstances this must result in the supremacy, more or less, of some of the colonies.

I have made, for some time, regular monthly tests of the Metropolitan water supply, which will be found in Table III.

Without entering into details, which have been explained month by month in *Engineering* and the *Journal of Gas Lighting*, I wish to express in the first instance the great satisfaction it has given me to find on the showing of those figures that our water supply, as a whole, is bacteriologically so much purer than, I venture to say, anyone would have anticipated. I will confine myself to a comparison of the figures obtained by Dr. Frankland and myself for the months ending November, 1885, for which we made parallel reports. Taking the total, we both place West Middlesex first; second, New River; and third, Kent. I then place Southwark fourth and Chelsea fifth; Dr. Frankland reversing these two figures. Of the last batch I place Grand Junction

sixth, East London seventh, and Lambeth eighth; Dr. Frankland finding East London sixth, and Grand Junction last. Considering that the almost half-a-hundred samples here embraced were taken quite independently at different times, and several in different localities, those three months certainly agree as well as any method of chemical analysis. Let me nevertheless assert emphatically that if my figures place West Middlesex first and New River next, I do not mean by this that there is any practical difference

New River water and 1 per cent. of sewage were added. All these bottles were fixed in one frame, which was alternately inverted with a jerk up and down 500 times. Each bottle was then shaken up and a portion of the liquid passed at once through a small Swedish filter into a flask for examination, the filter and flask being sterilised. I prefer this to a settling up to 48 hours, as in the latter case the absence of colonies may be due rather to subsidence than to the treatment. However, the results in the

TABLE III.—COLONIES IN 1CC.

	SEPT.		OCT.		NOV.		DEC.		JAN. (1886).	
	Liq.	Total.	Liq.	Total.	Liq.	Total.	Liq.	Total.	Liq.	Total.
Thames Water below Sunbury Lock..	—	—	—	—	84	8200	—	—	—	—
Do. at London Bridge	—	—	—	—	560	45000	—	—	—	—
Intake from Lea at Chingford Mill ..	—	—	88	1300	—	—	—	—	—	—
Sample taken at Lea Bridge	—	—	12000	1200000	—	—	—	—	—	—
Chelsea	3	35	3	48	2	10	5	110	16	470
Grand Junction	0	28	4	82	1	54	20	1400	23	2600
Lambeth.. .. .	1	45	7	77	9	76	2	88	16	1200
Southwark	1	35	2	34	1	49	7	260	—	—
West Middlesex	0	20	—	—	1	10	0	60	10	130
East London	5	61	3	89	3	22	18	400	20	140
New River	1	13	0	11	1	53	3	70	3	160
Bath Well, Deptford	—	—	—	—	—	—	0	6	—	—
New Well, Deptford	—	—	—	—	—	—	0	4	—	—
Covered Reservoir, Deptford	—	—	—	—	—	—	5	87	—	—
Kent (supply).. .. .	0	50	0	25	5	65	4	31	2	26

between them. In fact, as far as I read the results at the present moment, there is not much to choose between the supply of the different companies up to December, when the colonies in the supply of two or three of them rose somewhat high, probably owing to the rains and floods then prevailing. Dr. Frankland has applied the test to show the improvement of liquids by certain treatments. The experiments in Table IV. were made somewhat differently:—

TABLE IV.

	At Starting.		After Six Weeks.	
	Liq. Col. 57.	Total Col. 4600.	Liq. Col.	Total Col.
New River Water and 1 per cent. Sewage.				
Shaken with:—				
Animal Charcoal..	0	39	89	53,600
Coke	1	11	18	92,600
Iron Filings	1	130	24	11,600
Sand	2	970	13	1,900
Spongy Iron	0	12	0	314
Wood Charcoal ..	0	16	53	22,600

The materials mentioned in the table were passed through a sieve with 8 meshes to the linear inch, the portion that passed through a sieve with 30 meshes being rejected; 100cc. of each material were introduced into a stoppered 300cc. bottle. Bottles and materials were sterilised by heat in the usual way, and after cooling, 150cc. of a mixture of

first two columns agree sufficiently with those given by Dr. Frankland to show once more the reliability of the test when applied to such experiments. The great difference which I found in the behaviour of spongy iron and iron filings is remarkable, due probably to the porosity and greater surface of the former, and to the well-known greater chemical affinity of metals which have not undergone fusion.

In the course of the discussion on Dr. Frankland's paper, reference was made to the importance of ascertaining the relative lasting purifying power of different materials, and this induced me to add the second pair of columns. After taking the samples as explained, the bottles were filled up to the mark with the 1 per cent. sewage, and the materials shaken up and left to stand for 24 hours. During six weeks 100cc. of the liquid were then daily syphoned off, another 100cc. of dilute sewage being added, mixed, etc., as above. The shaking of the frame having been finally repeated, the figures in the third and fourth columns showed that spongy iron alone was still capable of a purifying action to any great extent.

HARMLESS AND HURTFUL COLONIES.

I feel considerable diffidence as a chemist in touching upon the harmlessness and hurtfulness of microphytes, which is involved in much doubt. To begin with, the all-important question whether the living poisons have been created as such, or are modifications of harmless forms, is in a very unsettled state. I determined, as a first step, to collect whatever evidence I could about the colonies met with in testing water, which I now beg leave to lay before you.

1. The influence of a neutral cultivating medium, or rather one which is slightly alkaline, was demonstrated by cultivation in gelatine, which had not been neutralised. The result was that 1600 liquefying, or a total of 710,000 colonies were reduced to 4 liquefying or a total of 121,000 colonies when neutralisation was omitted. Under the lens the colonies in both samples appeared very much alike, but in the acid preparation they were smaller, not unfrequently irregular in shape, and generally gave the impression of not being well developed.

2. An experiment was tried with a view of ascertaining whether the germs, which are the centres of the future colonies, can be destroyed by mechanical force. Four vertical rakes, each with six teeth projecting towards the centre, were fitted into a stoneware jar, whilst in the centre a spindle revolved, having four rows of seven teeth each, projecting towards the circumference, and so arranged that the teeth of the spindle worked between those at the circumference, almost touching them. The jar was filled with a sample of water containing 1600 liquefying, or a total of 710,000 colonies per cc., and a water-tight lid having been screwed on, the spindle was made to revolve 7424 times during 10 minutes, or 12 to 13 times per second. Under these circumstances nothing appreciable was gained. This result is interesting in connection with the shaking of water with the materials (Table IV.), as it indicates that any destruction of organisms during this treatment was in all probability not due to a mechanical action.

3. The upper range of temperature at which colonies develop freely being sufficiently known, I ascertained that up to $7\frac{1}{2}^{\circ}\text{C}$, no colonies whatever were developed in a sample of New River water, with or without the addition of 1 per cent. of sewage. As the development of organisms in samples of water unquestionably similarly depends upon the temperature, this has to be taken into account when interpreting results.

4. The following table (V.) relates to an experiment made in order to inquire what effect it has upon samples of water if air be passed through it under varied conditions.

60cc. of sample A were filled into each of three flasks in the usual way. The plug was removed from one of them, and immediately an indiarubber stopper introduced, through which passed two glass tubes—one of them dipping slightly below the surface of the water, the other ending in the upper part of the flask. Stopper and glass tubes had previously been sterilised by steam. The short glass tube being connected with an aspirator, 10 litres of the laboratory air were sucked through the water, with the result that, instead of being increased the total colonies were reduced to almost one-half (B).

TABLE V.

	Liq. Col.	Total Col.
A.—New River Water	1	53
B.—10 litres of air sucked through ..	1	29
C.—Ditto from top of Winchester quart, filled to two-thirds with sewage	2	53
D.—Ditto after bubbling through the sewage	2	49

The stopper and glass tubes were then transferred to one of the remaining flasks and the inlet tube connected with a glass tube reaching into the upper part of a Winchester quart, filled to two thirds with very foul sewage. Ten litres of air being sucked through in

this way, about the same number of total colonies were found as in the untreated sample (A). The experiment was then repeated with the third sample flask, after pushing the inlet tube inside the Winchester quart two inches below the surface of the sewage. The ten litres of air had therefore in this case to bubble right through the sewage, and yet the total colonies in the sample had certainly not increased (D).

These results are the reverse of what I expected. As experiments C and D seem to exclude the suggestion that germs had been carried off from the contents of the flask in experiment A, they have apparently been destroyed by the current of air—whether by oxidation will have to be decided by further experiments. Results C and D are of some importance in connection with the pollution of water in cisterns by sewer gas. It is variously assumed that disease germs have the property of escaping with sewer gas. In this case they must behave differently to the sample experimented on, but I will not lay myself open to the suggestion that I approved of a connection between cisterns and sewer. If for no other reason, this should be rigorously avoided for the sake of the most ordinary cleanliness.

(5.) Several experiments were made to ascertain the comparative effect of keeping samples during incubation in complete darkness, instead of exposing them to diffused light.

TABLE VI.

Sample Liquid.	Cultivated in Diffused Light.		Cultivated in the Dark.	
	Liq. Col.	Total Col.	Liq. Col.	Total Col.
New River Water ...	3	70	1	28
" " "	5	110	4	200
" 1% of Sewage" and	64	99,000	34	1200
New River Water and 1% of Sewage	178	500,000	218	603,000
East London Water ..	20	110	6	93
Kent Water	2	26	1	16

The preceding table shows that in the dark a more or less considerable reduction took place in four out of six parallel experiments. The increase in the ease of the second sample of New River water is explained by the presence of quite an unusually large number of colonies of *Penicillium glaucum*, which thrives well in darkness. After deducting these colonies, the sample cultivated in darkness gives sixty-two total colonies, and the other seventy-four. Unfortunately it was omitted to keep a record of the colonies of *Penicillium glaucum* present in the fourth experiment, which is the only other one showing an increase when cultivated in the dark.

(6.) Allow me to call attention once more to Table I. The sample of New River water on the first day in series A might have contained once again as many total colonies, and would still have been styled "very good" by Dr. Koch. A sample containing 770,000 colonies would certainly be considered of extremely doubtful purity. Has then the New River water become a poison by being kept at a fairly low temperature for six days, in a sterilised flask, secure against aerial contamination? Sausages, pork pies, or even beefsteak pies sometime become poisonous on keeping, through the formation of an, as yet, unknown substance; but surely this does not

apply to water under the above conditions. Following the rule that samples must be tested directly after taking, the colonies on the sixth day are of no great importance for the purposes of our test; but we may ask why it should make such an enormous difference in the interpretation of results, whether a standard of the sanitary condition of water be applied a few days later or earlier, knowing, from experience, that the sanitary condition of water does not change materially within that time. Water is stored by companies, and has to be kept frequently by consumers much longer than those samples were. What are we to do with the result, if the number of colonies found were due to such storage? I have no answer; but we must try to work this out. It almost appears that what we are testing is not so much the sanitary condition of water, as the condition under which it has been kept.

Dr. Koch styles a sample of water "very good" which contains as many as 100 total colonies. I have adopted this standard from the beginning for three reasons. First, as coming from one who has had more experience with the test than anybody else; second, because the supply of such water seemed attainable, even under by no means exceptionally good conditions; and lastly, as a safeguard against unreasonable interpretation by outsiders. Nevertheless, I look upon the number of colonies as raising rather relative than absolute standards—that is to say, its strength lies in the comparison of samples which have a like history, and which have been obtained and tested under like conditions. Microphytes multiply differently, some more rapidly than others; and, relatively, harmless microphytes may have an enormous progeny, resulting in a large number of colonies, whilst more important pathogenic microphytes may multiply less rapidly, and although productive of fewer colonies, would have a much more serious bearing upon the quality of a sample of water than the former. It will, indeed, scarcely be doubted that one single cholera or typhoid germ outweighs millions of harmless microphytes, which abound everywhere.

(7.) Two gelatine plates have been prepared by me, cultivated in the usual way. One is only nutritive gelatine, which was exposed for an hour to the air of my laboratory, the other a culture of New River water; and several, if not all of the colonies on the former will be recognised on the latter. If we were to condemn ourselves to drink sterilised water only, we should be washing down from our mouth these very same germs which result from infection by air. These germs cannot be hurtful, or the human race would long ago have become extinct. Of course, everything in excess—even the most wholesome food—becomes a poison; and therefore, also, these harmless colonies. But looking at Table I., I think we may safely assume that they are harmless within a very wide range, and I therefore propose that these colonies, as a beginning, might be styled "harmless," others "doubtful," reserving the term "hurtful" only for specific germs of disease, which we may be in a position to recognise. The colonies of the ubiquitous *Penicillium glaucum*, which appear in some cases in great numbers in culture of samples, are, in my opinion, entirely, or at least practically entirely, due to infection by the air of our laboratories. These, I think, might be omitted in counting colonies.

(8.) I have attempted to gain information about harmfulness or hurtfulness of colonies in yet another way, by keeping for some months a record of several distinct colonies, with a view of ascertaining whether some of them may be associated with pure, and others with sewage polluted water, as we associate trout with a clear mountain stream, and carp with a dirty pond. Much more extended experience

will be required before conclusions can be drawn from these records. It is further worth our attention to consider whether the diminution of colonies, when cultivating in darkness, shown on Table VI., may not be made use of for facilitating the detection of pathogenic microphytes. These, undoubtedly, are capable of development in the dark, otherwise they could not develop within the animal body. In any case I do not think there can be a reasonable objection to the rule that all cultivations be made in the dark, whether or not the important result referred to may be attained.

However, Dr. Koch has told us distinctly that we are to go beyond the simple culture in nutritive gelatin on glass plates and the counting of colonies by means of a lens. We must resort to the microscope and examine the colonies. You have seen the plate with a culture of New River water. Here is another with New River water, but with one of the lowest magnifying powers of a microscope you will detect in the latter sample distinct colonies of the *Comma bacillus*, the sample of water having been infected with a pure culture of that microphyte. This would very likely have escaped an examination with the lense only, though a practised eye, even unaided, will recognise indications which are lost to a beginner.

We must go still further. Dr. Koch recently stated about the *Comma bacillus*, it must be seen under the microscope, as it grows on gelatine, and on potatoes. The proof of its identity does not lay in any single test, but in a combination of those three tests. This applies throughout to our endeavours to classify colonies when testing samples of water. If we want to define colonies we must make pure cultures of them (shown experimentally), to be further cultivated, under appropriately varied conditions, in sterilised broth or other medium. This enables us to examine the microphytes, with a high oil-immersion power and Abbe's condenser, alive in a minute drop suspended on a microscopic glass cover, or dead after evaporation of a drop of the liquid, and tinting by methyl blue, etc. The result is a set of slides, such as you have before you, of water from Lea Bridge, the river Thames, the Metropolitan water supply, or the *Comma bacillus*, all of which remain a permanent record of the test. But even there Dr. Koch's test does not end. He tells us how to search samples for living organisms by examining on a glass cover a small drop of the water, or of its residue; another drop being again dried and tinted.

Some of the experiments I have explained are, as far as I know, the first of the kind. They are capable of extension in various ways, and if they should stimulate others to follow in the same lead, or, still better, to extend research in other directions, I shall not require an apology for having taken up your time this evening.

DISCUSSION.

The CHAIRMAN said they were all agreed that even scientific chemists should confine themselves to chemistry as far as possible; but it was increasingly evident that, far more than scientific chemists, industrial chemists could not do so at all. They were constantly brought in contact with problems necessarily involving other sciences, especially biology. A more practical question than the purification of water could not be suggested. Although similar questions were cropping up everywhere, this was one of the most practical; and all scientific engineers, at any rate, were specially interested in it. No doubt it was most desirable to have water delivered as free from all organisms as possible; and anything which

could be brought forward as to the character of these organisms should not be hurriedly passed over, nor too patiently and carefully worked out. Any light which could be thrown on the really dangerous and poisonous organisms by this mode of testing would much enhance its value. At present it was only tentative; but was still perhaps the most valuable of all the methods of water testing, although still falling short of perfection.

Professor ARMSTRONG said no doubt at the present time it was most important to have the fullest possible information on the subject of water supply. It was most desirable that chemists should discuss these matters amongst themselves, and so obtain some method which would enable them to pronounce an opinion; but up to the present time they were absolutely unable to make any use whatever of this information. What was wanted was a regular comparison between this method of operation and the ordinary method, combined with a careful examination into the history of water. By this method of research, they might gradually be in a position to make some use of these operations; but at present it was most desirable that statements should not be put forward to the general public which could only have the effect of frightening them.

Dr. PERCY FRANKLAND said at that late hour of the evening, he could not venture to refer to the many notes which he had made during the reading of the paper; but he would just refer to a few points, and afterwards come back to the one Professor Armstrong had just raised, in which he certainly differed from him. He had recently had an opportunity of studying these operations in Dr. Koch's laboratory; but neither in conversation with Dr. Koch, nor in the course of his lectures, had he ever heard him put forward the standard of 100 colonies per cc. as constituting a safe and desirable water. If ever such a statement were made, he should certainly not be prepared to endorse it. It was perfectly true that taking a water in its natural condition, and finding it with less than 100 organisms one would probably be near the truth in saying that it was a pure water, and such a verdict would most likely be substantiated by chemical analysis and an inquiry into the origin of the water; but to make a general declaration that water containing less than 100 organisms, be they what they might, was safe was not at all desirable. With regard to the details of the process, they differed in no essential way from his own. Dr. Koch's arrangement with the ice-plate was exceedingly convenient, and he now adopted it himself, as it enabled him to do in the course of an hour what formerly took a whole day. But, on the other hand, it must be borne in mind that the process of transferring from the frozen plate to the dishes might introduce a few colonies from the air—notably the *Penicillium glaucum*. It must be borne in mind that there were two difficulties to contend with—viz., the introduction of aerial organisms, on the one hand, and the destruction of organisms in the water on the other. By the use of the ice-plate some atmospheric organisms would generally gain access, whilst by the use of mercuric chloride, although aerial contamination was wholly obviated, there was a danger that some of the organisms in the water might be destroyed; on this account he no longer used mercuric chloride, but preferred simply to employ sterilised water instead. With regard to Mr. Bischof's practice of keeping the plates incubating for three days only, he was not satisfied that this was the best mode of procedure. At the best, a certain fraction of the total number of organisms present developed; and the object was to develop as many as possible. The plates, therefore, ought to stand until the colonies which appeared

threatened to merge one into the other; so that the water which contained a great number of organisms must of necessity be incubated for a shorter space of time than one which had a smaller number. This was the practice now followed in Dr. Koch's laboratory. This, however, was only a matter of detail; and the results were, on the whole, in very fair accord with his own. With regard to the development of organisms in gelatine-peptone, he did not think Mr. Bischof had quite done justice to the developing power of this substance. This mixture which he had mentioned was really one of the best developing media they were acquainted with, and was well fitted for the development of most pathogenic organisms—those of cholera, typhoid fever, erysipelas, pneumonia and diphtheria, all grew in this gelatine. As regarded its being a quantitative process, this had already been shown very strikingly. A case had come before him that day where three samples of the same water gave as the result of three different plates 4889, 4527, and 4603 colonies. With regard to shaking-up experiments, he confessed he was much surprised that, without subsidence, they had come out as favourably as they had. In the results he obtained on shaking up with coke and various other substances, the materials were allowed to subside; his idea being that the particles carried down with them in subsidence the organisms present. Then, with regard to the pathogenic and non-pathogenic microphytes, this was perhaps not the place to discuss the old question of spontaneous generation. They knew there must have been spontaneous generation at some time in the history of the world; but there was absolutely no evidence that this took place at the present day, and positively no satisfactory evidence existed that pathogenic organisms had been developed from non-pathogenic ones. This was the whole tendency of recent biological and pathological research. The experiment of development in acid gelatine presented a certain interest if the acidity of the human stomach were imitated in the gelatine; but it must be remembered as a matter of fact that there was scarcely any pathogenic organism which, in the condition of the fully developed organism, could stand the acidity of the stomach. In the condition of spores, however, they could; and if they passed the stomach in the spore stage, and got into the alkaline medium present in the intestine, they had all the facilities there for growth, and the production of their virulent properties. He need only again refer to the classical *Comma bacillus*. This organism was destroyed with the greatest facility by acid liquids. Hydrochloric acid in a dilute form was immediately fatal to the bacillus. This bacillus was not known to form spores—at least, Dr. Koch had never been able to obtain spores from it; but if it were introduced into the stomach of an animal in which an alkaline reaction had been induced, then the *Comma bacillus* entered the intestine, and multiplied and produced the characteristic disease. With regard to the air experiments, he confessed he was not surprised at the result. It was quite a familiar phenomenon to see smoke of various kinds bubbling through water without being absorbed, and, in the same way, these exceedingly fine suspended particles were not caught by the water at all. They did not come in contact with it; there was a repulsion between them and the water. The case of sewer gas was somewhat different; and he did not think a generalisation from this experiment to the case of sewer gas ought to be allowed to pass unchallenged. It must be remembered that sewer gas was not only gas, but it bore liquid particles with it. These liquid particles were carried by the gas from the sewer, in which a process of fermentation was going on. Now these liquid particles con-

tained micro-organisms, and on coming in contact with water in a cistern, for instance, they would be rapidly absorbed, because not being dry, there was no repulsion between them and the water, and they would become incorporated with it. Lastly, he came to the point of what was the use of publishing the results obtained by this process with the London waters. What had been the object of water engineers hitherto in filtering water, and in erecting expensive filter-beds? Had they intended to diminish the chemical impurities in water? Chemical analysis showed that they reduced them very slightly indeed. Did they design the filters to remove the particles of mud, clay, and so forth, which the rivers carried down with them? If they had done it for this purpose, they had acted on a very wasteful principle, because these substances were harmless. They had done this because there had been an innate feeling that there was something invisible in water which might be detrimental to health; and they had carried on these filtering operations at great cost, and had performed them with ever-increasing care, although they had had little encouragement given to them. The results obtained by Mr. Bischof and himself, in comparing the number of micro-organisms in the unfiltered waters of the Thames and Lee with the waters after filtration by the Water Companies showed distinctly that the improvement which took place in the filtering process was most remarkable. No one had ever thought such a thing possible before. The improvement chemically was almost *nil*; but the improvement from the biological point of view was most striking. He had now carried on these examinations by means of the gelatine process for upwards of a year; at frequent intervals, he had also examined the unfiltered waters; and the reduction that took place in the number of micro-organisms during filtration amounted to 95 or even 98 per cent.; in some cases the reduction was very much greater, but this was the average. He could only say that far from these results which Mr. Bischof and himself had published being of an alarmist nature, they were of an entirely opposite character, and ought to reassure the public that this process of sand-filtration, which had hitherto been regarded by most authorities on water supply as only of little value, was really an exceedingly important process in rendering river water more fit for domestic use.

Mr. FLETCHER asked if Mr. Bischof had tried passing sterilised air through the affected water to see whether the oxygenating action of the air was not acting in its favour—that is to say, when he drew air charged with organisms through the water, possibly the oxygenating action of the air counteracted the evil action of the organisms which he drew with it.

Mr. NEWLANDS asked if the animal charcoal employed was new animal charcoal with all the salts in it, or in a common working condition, so as to yield the best possible results—for instance, had it been at work in a sugar refinery for two or three months. With regard also to the coke, it would be useful to know the size, and whether it was finely divided, in which case he knew, from personal experience, it would take out a vastly greater amount of organic matter and mineral matters than when in a rough state. It would also be important to know whether the coke was an average sample. The same with regard to other materials employed—the iron filings, and the spongy iron and sand—were they fine or rough?

Mr. BISCHOF, in reply, apart from what Dr. Frankland had urged, maintained that it was of the utmost importance that different experimentalists should be able to compare results, as without this no progress

could be made; and how could they compare results if they kept the results in their note-books? If Dr. Frankland would favour him with a call, he would show him that, in his remarks on the subject of this water test, Dr. Koch stated of a sample in which he found 100 total colonies, that this was "very good."

Dr. P. FRANKLAND said perhaps he knew the origin of the water.

Mr. BISCHOF said he was very much afraid that factor could not be taken into account. The history, of course, must be taken into account; but the origin, whether it were deep well or river water, did not make much difference if it contained a certain number of colonies. He thought Dr. Frankland would also find that certain pathogenic microphytes could not be cultivated at all. As to the air bubbles not being in contact with the water, surely it must be remembered that the circumference of these bubbles was in contact; and it would be strange if some organisms were not carried with the air, especially when they knew how easy it was, as had been shown by Professor Tyndall, to purify air simply by moistening a glass dish with glycerine and leaving it for an hour, when it was found that all the germs adhered to the sides. With regard to the difference which Dr. Frankland had referred to, of sewer air containing liquid particles, he would point out that the moisture also contained liquid particles. He had not passed sterilised air in this way through a sample, because his object was to get an infection. He had tried in all possible ways to get a sample infected, and had not, therefore passed sterilised air through it; but he intended to extend his experiments very largely, and he would try this experiment. With respect to the condition of the materials, he had stated in the paper that they were all passed through a sieve of thirty meshes to the linear inch, and, therefore, the physical conditions were the same throughout; none of the materials were selected. He simply took the samples at random. They might have been fair or unfair in one case or the other; but he thought it was the fairest way to take them in their ordinary condition. The animal charcoal was in the same state as that in which it was purchased.

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Meeting held Monday, March 1, 1886.

MR. DAVID HOWARD IN THE CHAIR.

ON VISCOSIMETRY, OR VISCOMETRY.

BY ROBERTON REDWOOD, F.L.C., F.C.S.

IT is my intention this evening to treat the subject of viscosimetry, or the determination of viscosity, as related to the valuation of oils intended for the lubrication of machinery, and I make no apology for the selection of the subject, since the testing of viscosity is an operation which the practical chemist is frequently called upon to perform.

The introduction and rapidly increasing employment of mineral lubricating oils as substitutes for the fixed oils previously employed, have given an importance to the accurate determination of the viscosity, or body, of lubricating oils, which did not previously exist. Different samples of any given fixed oil, such as sperm oil or rape oil, vary in viscosity only within comparatively narrow limits, at a given temperature, and an engineer accustomed to use a fixed oil would in purchasing such oil derive little advantage from a knowledge of the viscosity of the sample. On the other hand, mineral lubricating oils may be manufactured of any required viscosity within limits which are wide, and it therefore follows, that having com-

menced the use of a mineral oil which affords satisfactory results, it is in the highest degree important that the engineer should be able to ascertain whether further supplies of this class of lubricant are of a viscosity similar to that of the oil already employed.

When mineral lubricating oils first came into general use it was assumed that the viscosity bore some tolerably definite relation to density; and accordingly the specific gravity of the oil was regarded as a fairly satisfactory test of its suitability. It is only within recent years that it has become recognised that the specific gravity of an oil is a worthless test of its lubricating properties; since an artificial mixture of comparatively light and comparatively heavy hydrocarbons may have the same density as the natural mixture of hydrocarbons composing a good lubricating oil, and yet be deficient in the properties of a satisfactory lubricant.

In order fully to realise, however, the importance of the determination of viscosity in mineral lubricating oils, and the value of a good test of viscosity, it will be necessary for us briefly to consider the laws of the friction of fluids, as applicable to the circumstances under which liquids are employed in the lubrication of machinery.

These laws, as is well known, differ very materially from those which govern the friction of solids, though it is important to bear in mind that the friction in the case of the lubricated rubbing surfaces of machinery in motion is usually a compound friction made up of the friction of solids, and of the friction of fluids in proportions varying according to the circumstances of the case.

The friction of solids in motion is of two kinds—viz., sliding friction and rolling friction. It is, however, only the former class of solid friction which now demands our attention. In sliding friction the magnitude of the resistance is, up to the point of abrasion, dependent upon the character of the surfaces, and proportional to the force with which they are pressed together, though in the case of lubricated surfaces the resistance may be principally due to the adhesion when the pressure is very low. In fluid friction, on the other hand, whether of liquids or gases, the resistance is proportional to the area and velocity of the surface exhibiting it, and to the density and viscosity of the liquid. As Professor Thurston* expresses it: "Fluid friction is therefore the friction of adjacent bodies of fluid in relative motion, and is due to the formation of small whirls or large eddies in the two bodies, the production of which absorbs energy from the flowing mass. The friction of the fluid finally extinguishes this energy of eddy-motion, converting it into heat, and raising the temperature of the mass by the introduction of the heat equivalent of the mechanical energy thus destroyed. The resisting property which thus effects this conversion, and which is the cause of fluid friction, is termed viscosity. . . . In the case of limpid liquids and gases the resistance is of a kinetic character, rather than one due to intra-molecular action; but the flow of viscous liquids is evidently greatly influenced by their molecular constitution."

In most cases, as I have said, the friction of the lubricated surfaces of machinery is a compound one, but in some instances it is found practicable to float the moving part in the lubricant, and under such circumstances the resistance is due only to fluid friction. On the other hand, in the case of slowly moving heavy machinery the resistance is usually largely made up by the friction of solids.

It follows from what has been said, that in theoretically perfect lubrication the resistance would be independent of the pressure, and the nearer we can approach to this condition in practice the better.

The more viscous the lubricant and the stronger the attraction taking and holding it between the moving surfaces, the greater the pressure which can be sustained; but unnecessarily high viscosity creates unnecessary fluid friction, and the viscosity of the lubricant should therefore be in proportion to the pressure. In other words, the lubricant should have only just sufficient viscosity to keep the moving surfaces apart, under the maximum pressure.

The amount of viscosity required in a lubricant, therefore, varies according to the circumstances under which the lubricant is to be used. It is obviously dependent not only upon the load carried upon a given area, but also upon the fit of the bearing surfaces, and upon the character of the motion. Thus, the axles of railway trucks are subjected to pressures greatly in excess of the load carried, when the vehicle is passing over inequalities in the permanent way. It has also been found that the power required to drive machinery which has been lubricated with an oil sufficiently viscous to keep the moving surfaces apart, is diminished when a more fluid lubricant is substituted.† It is true that this diminution of resistance is accompanied with greater wear of the metallic surfaces, and greater expenditure of the lubricant, but in the case of factories provided with insufficient motive power it may be preferable to have less theoretically perfect lubrication.‡ In a cotton mill, for instance, the use on the spindles of a very slightly better, in the sense of a more viscous, lubricant, though increasing the fluid friction between the bearing surfaces of each spindle only to an infinitesimal extent, might arrest the motion of the whole machinery of the mill.

Largely for these reasons, no doubt, the many ingenious machines of Ingram and Stapfer, Thurston, Woodbury and others, designed to test the lubricating value of oils, have not hitherto given results of much practical value. With some of these machines strictly comparative data of lubricating power under the conditions present in the machine can be obtained; but as these conditions frequently differ from those presented in actual practice, the deductions drawn from the data may be misleading.

Professor Thurston himself admits that the use of the testing machine to determine the relative friction reducing power and wear, and the endurance of oils, as data for use in the solution of the commercial problem, will often be found to involve some difficulties. These difficulties arise, however, not from faults of the method, but, as he says, from the exceedingly great uncertainty often existing as to whether the conditions of test are precisely those of use. He adds that a good testing-machine may be relied upon, if properly handled, to give accurate data; but it can rarely be made equally certain that the same conditions can be permanently retained when the lubricant is put in service. Satisfactory approximations may, however, in his opinion, readily be secured, with careful supervision and ordinary skill, for all

† It has been well said that many an engineer wastes tons of coal in an attempt to save gallons of oil.

‡ Mr. Thurston points out that the measure of the co-efficient of friction alone is not always a gauge of the value of an oil. A low co-efficient is sometimes found to co-exist with serious wear, and even low friction and a cool journal may be accompanied by wear. With very light pressures and high speeds, as with fast-running spindles, light mineral oils sometimes give low friction, and yet produce rapid wear. Mr. F. W. Arvine found that a cotton spindle, after running for some time at a speed of 6500 revolutions per minute with a fluid oil, lost as much as one-tenth gramme in weight.

* "A Treatise on Friction and Lost Work in Machinery and Millwork." By Robert H. Thurston, A.M., C.E. John Wiley & Sons, New York, 1885.

cases in which the machinery is well proportioned, in good order, and well cared for. Mr. Thurston further remarks that experiments made upon the nicely fitted journal of a testing machine are not conclusive as to suitability of a lubricant for use on a similar journal which is not well fitted. The latter bearing only in spots, or along lines of contact, is subjected on such surfaces of contact to pressure which may be enormously heavier than that affecting the same journal when wear or refitting has given it a good fitting, and the best lubricant is therefore one adapted to such intense pressure. Could the magnitude of this extraordinary pressure be known, a good testing machine would determine which of any collection of oils is best fitted to sustain it. The testing machine determines the behaviour of oils upon its own journals; if those on which the lubricant is to be used are similar, its behaviour will then be the same. While the machine does not usually serve to select oils for badly made surfaces, it exhibits the intrinsic qualities of the oils tested; and every mechanic and engineer endeavours to get all journals into as good condition as those of the testing machine, and thus fit them to do good work with good oils. Mr. Thurston also expresses the opinion that in order to determine precisely what oils are adapted to any special purpose, or to ascertain for what use any oil is best fitted, it is necessary to make an examination of the lubricant while it is working under the specified conditions. That is to say, the oil should be put upon a journal of the character of that on which it is proposed to use it, and subjecting it to the pressure proposed, running it at the speed that the journal is expected to attain: its behaviour will then show conclusively its adaptability to such an application.

I am indebted to Professor H. B. Nason, of the Rensselaer Polytechnic, Troy, State of New York, for sending me some valuable papers on the subject of the testing of lubricating oils by Professor Ordway and Mr. C. J. H. Woodbury.* The experiments conducted by Professor Ordway, in association with Mr. Atkinson, had for their object to determine, among other points, the extent to which spindle oils in common use were liable to spontaneous combustion when absorbed by cotton-waste or other similar material, as well as the temperature at which they evolved inflammable vapour. But I have referred to the investigation chiefly because these gentlemen report that three machines—two American and one English—which they had obtained with the view of testing the lubricating power of the oils under examination, furnished no satisfactory results; and it was accordingly found necessary to substitute for these machines an ordinary spinning frame, with a thermometer applied to each spindle, the heat evolved being regarded as a measure of the friction. Mr. Woodbury's papers are largely devoted to a description of the results obtained with the well-known testing machine of which he is the inventor. In the first paper it was pointed out that friction varies with the area, because the adhesiveness of the lubricant is proportional to the area, and the resistance due to this cause is a larger fraction of the total mechanical effect with light, than it is with heavy pressures. Accordingly, as the results of the preliminary work indicated that the coefficient of friction varied with all the circumstances, it was found necessary to simulate the conditions of specific

practical applications to determine the value of a lubricant for such purposes.† In Mr. Woodbury's second paper the results obtained with a modified form of apparatus constructed to carry pressures up to 40lb. per square inch were given. The experimental data contributed by Mr. Woodbury, supplemented by those reported by Mr. Beauchamp Tower in this country, constitute a comprehensive series, since Mr. Tower operated at great pressures (100lb. to 625lb. per square inch), though with a special method of lubrication (the oil-bath system); but in the discussion which followed the reading of Mr. Woodbury's second contribution, it was pointed out by Mr. F. W. Arvine, chemist of the Thompson and Bedford Company of New York, manufacturers of lubricating oil, that the agreement between the results yielded by testing machines and those obtained in actual practice was unfortunately very small.‡

As the Pennsylvania Railway Company have paid considerable attention to the testing of lubricating oils, it is instructive to find that at the end of last year the opinion of Dr. Charles B. Dudley, chemist of the company, who has studied the subject of lubricants during the past ten years, was that the problem of diminishing the loss due to friction was complicated, and not well understood.

I have not had the opportunity of working with the machine of Professor Thurston or that of Mr. Woodbury, but some years ago I was engaged for many months in testing lubricating oils with the Ingram and Stapfer machine, and I found it impossible to obtain any results that were thoroughly satisfactory from a practical point of view.

In studying the records of the experiments made in the testing of lubricating oils with the various machines which have been devised for the purpose, I have admired the ingenuity and patience with which the results were arrived at. It must, however, be obvious that the indications afforded by testing machines may in the present state of our knowledge of the subject be wholly misleading, and it is this fact which has led me to attach great importance to the adoption of a good system of determining the viscosities of oils. To my mind, indeed, the most valuable result of the experiments made with testing machines has been the demonstration of the close relation which exists between viscosity and lubricating power. Professor Thurston has pointed out that this close relation is well shown in the curves on p. 124, which exhibit graphically the results obtained by Mr. Waite.§ The figures were obtained with lard oil and light paraffin oil, the full lines representing the readings obtained with the testing machine at different temperatures, multiplied by a constant, and the dotted lines the viscosity of the oil. The diminu-

† The working pressure in Mr. Woodbury's earlier experiments was 5lb. per square inch, and the speed 500 revolutions per minute, these conditions corresponding with the velocity and pressure of a Sawyer spindle running at 7600 revolutions per minute, with a band tension of 4lb. Mr. Woodbury stated that the intermittent pressure on the wrist-pin of a locomotive amounted in as much as 3000lb. per square inch. According to Professor Thurston, the maximum pressure on the crank-pins of heavy engines is 1200lb. per square inch, and under the pivots of drawbridges sometimes as much as 9000lb. per square inch.

‡ Mr. Arvine has relinquished the use of the various machines referred to, and now conducts his tests under the conditions of actual practice. When I was in New York last autumn I spent several hours in Mr. Arvine's laboratory, and noted that he used for the testing of spindle oils a frame of spindles, such as may be found in a cotton mill, and for the testing of heavier oils a railway-wagon axle, of the usual construction, capable of being loaded with the weight commonly carried. Both pieces of apparatus were driven at the ordinary speed, and were fitted with sensitive dynamometers and thermometers. An apparatus for testing cylinder and valve oils under practical conditions of temperature and pressure of steam was in course of construction.

§ These results were reported in the Proceedings of the New England Cotton Manufacturers' Association, 1880.

* Proceedings of the Semi-annual Meeting of the New England Cotton Manufacturers' Association, held at Boston, U.S.A., 30th October, 1878. Report by John M. Ordway, representing the Department of Industrial Chemistry of the Massachusetts Institute of Technology, and Edward Atkinson, representing sundry insurance companies. Transactions of the American Society of Mechanical Engineers, Nov. 1880, and Nov. 1884. "Measurements of Friction of Lubricating Oils," by C. J. H. Woodbury, of Boston, Mass., Inspector Factory Mutual Assurance Companies.

tion of viscosity with increasing temperature is a feature to which I shall have occasion to refer later. Mr. Woodbury states that within a close approximation the lubricating qualities of an oil are inversely proportional to its viscosity; that is, that the friction decreases with the cohesion of the globules of oil for each other. Although in succeeding remarks Mr. Woodbury somewhat qualifies the statement quoted, there can, I think, be little doubt that the determination of the viscosity of an oil affords the most valuable test of lubricating properties that we have at our disposal. There may be an advantage in testing the oil by using it under conditions to which it will be subjected in actual practice, but it is admittedly exceedingly difficult to determine precisely what these conditions are, especially in some cases, and still more difficult to reproduce them with certainty. On the other hand, if a certain oil has given satisfactory results under given conditions of fit, or want of fit of bearings, pressure, speed, and temperature, it may be predicted with tolerable certainty that another oil of the same nature, having a similar viscosity, will yield equally good results.

The simplest form of apparatus for the determination of viscosity consists of a glass pipette drawn out to a small orifice; such an instrument I hold in my hand. The pipette being filled to a mark on the stem with the oil to be tested, the time occupied in the flowing out of the contents, either wholly or to a

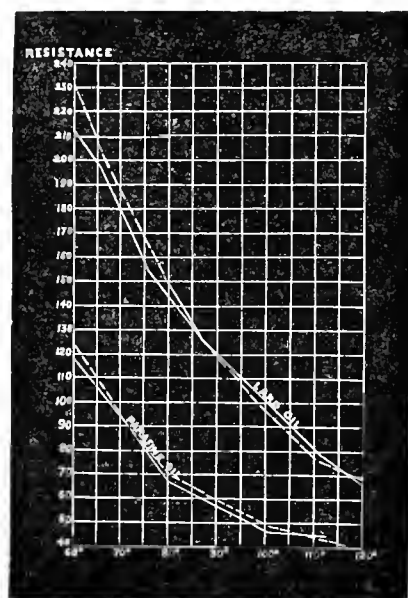


FIG. 1.

lower mark, is noted. This form of apparatus is still largely employed, the experiments being usually made in a room maintained at a temperature of 70° F. The simple pipette is, however, not adapted for use at high temperatures, and accordingly Mr. J. Veitch Wilson, Mr. W. MacIvor, Mr. D. N. Sacker, and others have proposed to surround it with a jacket containing water or other liquid, heated to the desired temperature. It is a serious objection to the pipette that the results afforded vary to some extent with the shape of the constricted portion of the tube. Two pipettes may be constructed with jets of such size that they deliver equal quantities of a given oil at a given temperature in a given time; but if the jets vary materially in form, the two instruments will not furnish concordant results with oils of greater or less viscosity than that of the oil with which they were

standardised. The fragile nature of the pipette also constitutes an objection in cases where the instrument has to be subjected to somewhat rough usage. In the jacketed forms of pipettes the column of oil is usually of considerable length, and it is difficult to maintain a uniform temperature throughout the oil during the experiment.

To the instrument employed by Mr. C. Rumble, chemist at the Battersea Works of Price's Patent Candle Company, these objections do not attach. This apparatus consists of a metallic cylinder of considerable diameter in relation to its length, provided with an agate jet, and surrounded with a water-bath. Mr. Rumble was good enough to let me have one of these viscosimeters some years ago, and I found that, although it did not possess the chief defects of the pipette, it was susceptible of considerable improvement. Thus, although great care was taken in boring the agate jet, there were marked differences between the results afforded by instruments constructed by the same maker, and professedly alike. Again, as the screw-cap, which carried the jet and formed the bottom of the oil cylinder, was provided with a leather washer the length of the column (the cylinder always being filled to overflowing), depended to some extent upon the thickness and elasticity of the washer and the force with which the cap was screwed on. Moreover, to keep the oil at a required temperature it was necessary to have the level of the liquid in the bath so high that there was danger of some of this liquid finding its way into the oil which was being tested. Finally, there was no arrangement for heating the bath, and this was a serious objection to the instrument when viscosities were required to be taken at high temperatures.

The viscometer designed by Mr. G. M. Saybolt, inspector to the Standard Oil Company of New York, is before you, and you will observe that the instrument consists essentially of an oil cylinder of large diameter surrounded by a water-bath of considerable capacity. The jet is of metal and is enclosed in a tube extending some distance below the orifice. Immediately above the jet the oil cylinder is contracted in size, and a portion is cut away on each side so as to expose an inner glass tube. At a corresponding level, glass windows are inserted in the walls of the water-bath. Round the upper part of the oil cylinder is fitted an oil-tight gallery with raised edge, and above the platform of the gallery the oil cylinder is pierced with a number of small holes. In the use of the apparatus the bath is filled with water at the desired temperature, and a cork having been inserted in the mouth of the tube enclosing the jet, the oil cylinder is filled with the oil to be tested, until overflow through the orifices referred to occurs, and the gallery is thus also partially filled. The outflow of oil through the jet is prevented by the pressure of the air enclosed in the outer tube in the space between the cork and the jet. The oil is then stirred with a thermometer, the gallery taking the overflow caused by the insertion of the instrument, and its temperature adjusted, if necessary. On withdrawing the thermometer, oil passes from the gallery into the cylinder through the orifices to replace that which had overflowed. The gallery is then emptied by means of a pipette, the length of the oil column in the cylinder thus being determined by the position of the circle of holes; the cork is withdrawn from the tube; a stop-watch concurrently started, and the operator, looking through the window in the side of the water-bath, and through the glass tube forming the lower part of the oil cylinder, notes the time at which the oil-level makes its appearance.

The Saybolt viscosimeter is not, however, as at present constructed, suitable for use at very high

temperatures, though at temperatures up to 200° F. it gives very satisfactory results.

For the determination of the viscosity of cylinder oils at 212° F., Mr. F. W. Arvine has constructed the apparatus on the table. In this instrument the oil passes to the jet through a copper tube coiled in a bath in which water is kept in a state of ebullition, and the thorough heating of the oil to the required temperature is thus insured.

Dr. Lepenan's "Leptometer," which is used to some extent on the Continent, consists, as you see, of two similar metallic cylinders, placed vertically side by side in a water-bath. Three pairs of interchangeable jets are provided, which can be placed in orifices in the stopcocks at the bases of the cylinders. Both cylinders having been filled with a standard oil, a pair of jets of such size that the oil is delivered in drops is selected, and the jets are tested by noting whether the same number of drops issue from each jet in a given time. The standard oil in one cylinder is then replaced by the oil to be tested, and the number of drops falling from the two cylinders respectively, from one coincidence of dropping to the next coincidence is noted.

The results are approximately correct when the oils are similar; but since the size of the drops varies in different oils, or with the same oil at different temperatures, and the size of the drop is therefore not necessarily a measure of the quantity of oil flowing through the orifice, this instrument does not yield comparative results with oils differing in character. Thus, to take an extreme case, I found that the number of drops of refined rape oil falling in a given time, at a certain temperature, was the same as the number of drops of a particular mineral oil, but the size of the drops of the rape oil was so much greater that 500 drops of the two oils weighed respectively 133·6 grains and 95·8 grains.

I also ascertained that of the No. 2 jets, supplied to me with the apparatus, one not only delivered rather a smaller number of drops in a given time, in the proportion of 27 to 28 (which is, I understand, within the limits of error accepted by the makers), but also formed slightly larger drops, 500 drops delivered by this jet weighing in some cases as much as 12 grains more than a similar number of drops of the same oil falling from the other jet, under precisely similar conditions.

It is evident that the rapidity of flow in the case of any of the instruments described depends to some extent upon the specific gravity of the oil. Hence an oil of high viscosity and high specific gravity compares less favourably with an oil of low viscosity and low specific gravity, than it would if both oils were judged on the basis of viscosity only. As far as I am aware the first published suggestion of an arrangement for eliminating differences due to specific gravity was made by Mr. W. P. Mason, of Troy, New York State. This gentleman described in the *Chemical News* of 31st October, 1884, an apparatus for determining viscosity, and proposed that the length of the column of the oil to be tested should be so adjusted as to be inversely proportional to the specific gravity, and should be maintained at this calculated length during the outflow of the standard quality.* Mr. Colin R. Strong, of Manchester, however, informs me that he had previously discussed with Mr. Napier, of Glasgow, the desirability of reducing the observed viscosity of an oil to a standard density, which, he thought, could best be done by calculation. Mr. Napier then prepared a sketch of an instrument, the oil cylinder of which was in two parts, connected by

a flexible tube. The upper part was supported in such a manner that it could be adjusted at any given height on a fixed scale, and its position was to be determined by the specific gravity of the oil. The movable part of the oil cylinder was provided with an overflow pipe, and by the use of a reservoir with a stopcock it was intended to produce a continuous slight overflow during the experiment, so that the oil level should be maintained at the fixed point. I am not aware that this instrument was constructed, for at this time Mr. Napier conceived the idea of taking the speed of a paddle-wheel revolving in the oil as a measure of viscosity. Through the courtesy of Mr. Strong, I am enabled to place before you the first instrument constructed by Mr. Napier on this principle. With this viscometer, although it is but roughly made, I have obtained some fairly concordant results. I have also on the table the second instrument made, as well as the latest pattern, in which, as you see, the paddle-wheel is attached to a vertical instead of a horizontal shaft, and the toothed wheels are kept above the surface of the oil.† In the last model, a jacketed vessel to maintain the oil at a required temperature, has, at my suggestion, been added. With both patterns the measure of the viscosity is the length of time occupied by the weight which drives the wheel in falling a given distance. Mr. Napier, however, proposes to add an index disc, connected with the paddle-wheel shaft, which will show the number of revolutions made by the paddle-wheel in a given time. The apparatus must be regarded as not yet having passed through the experimental stage, but I have obtained some very promising results with it, and I am of opinion that for some purposes it will be found useful. The principal objection that I see to it is, that the conditions under which the viscosity is determined are somewhat more complex than those which attach to the testing of viscosity in the ordinary manner, since we have, to a larger extent, the friction of oil against metal, as well as the unknown and variable quantity of the friction of the bearings and of the toothed wheels of the mechanism. It may, therefore, be somewhat difficult to construct a number of instruments in which the conditions of friction of fluid against metal, and metal against metal, are the same. On the other hand, oils containing solid matter (such as paraffin) in suspension can certainly be tested far more satisfactorily in such an apparatus than in an ordinary viscometer.

I may here mention that McNaught's testing machine, with which more than fifteen years ago I worked a good deal, although professedly made for the purpose of testing lubricating power, is really an instrument for measuring viscosity. The machine consists of two discs—the lower one provided with a raised edge and attached to a vertical spindle revolving in bearings; the upper one resting on a pivot. The space between the two discs having been filled with the oil to be tested, the lower disc is caused to revolve at a given speed. The upper disc is prevented from partaking of the motion of the lower disc, communicated through the oil, by a projecting pin which comes into contact with a pendulum: the extent to which the pendulum is removed from the perpendicular being the measure of the resistance of the oil.

The instrument which I lastly propose to describe is based upon the viscosimeter of Mr. Rumble. I have already pointed out the principal defects which I found this apparatus to possess, and I will now

* From a conversation I had with Professor Nason, in Troy, last autumn, I gathered that he had suggested to Mr. Mason the arrangement in question.

† A similar apparatus has been designed by Mr. E. Gordon Cockrell, of Manchester, who, while laying no claim to the idea of using a paddle-wheel, considers that he is entitled to the credit of having introduced practical improvements.

proceed to explain the modifications which I have introduced. The instrument, as you see (Fig. 2), consists of a silvered copper oil cylinder, about $1\frac{1}{4}$ in. in diameter, by about $3\frac{1}{2}$ in. in depth, furnished with an agate jet. I have somewhat increased the length of the cylinder, in order to work with the oil level some distance below the top. Instead of the cap, which forms the bottom of the cylinder, screwing in, it is a fixture; therefore, variations due to differences in the thickness of the washer are eliminated. The exterior of the agate jet and of its metal seating are made slightly conical, and the jet, having once been fixed in position, no dislodgment or leakage can occur,

agitator, which carries a thermometer to indicate the temperature of the bath, is so constructed that splashing is prevented. The oil cylinder is furnished with a stopper consisting of a small brass sphere attached to a wire, the sphere resting in a hemispherical cavity in the agate jet. A short standard, attached to the oil cylinder, carries a clip to support a thermometer in the oil. Inside the oil-cup and at a short distance from the top, is fixed a small bracket, terminating in an up-turned point. This pointed bracket forms a gauge of the height of the oil level, similar to that which is provided in Sir Frederick Abel's petroleum testing apparatus. In boring the

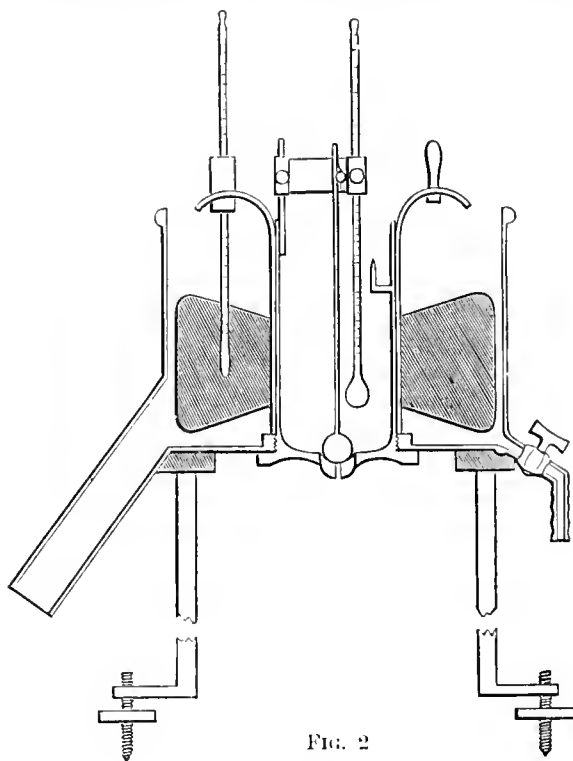


FIG. 2

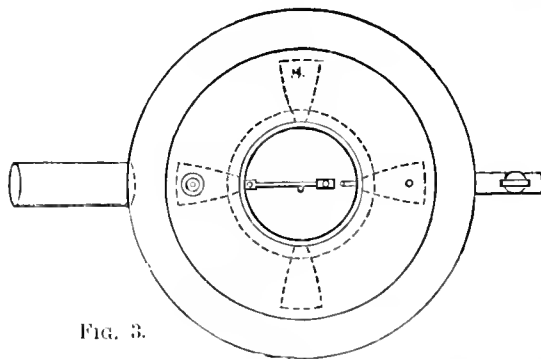


FIG. 3.

even when the apparatus is used at high temperatures. The copper bath, which surrounds the oil cylinder, is of such depth that the level of the bath liquid can be made to coincide with the oil level without any danger of overflow, or splashing into the oil cylinder. A copper tube, closed at the lower end, projecting at an angle of 45° from the side of the bath, near the bottom, provides a means of heating the bath liquid, and by the use of a revolving agitator, the heated liquid rising from the copper tube can be uniformly distributed through the bath. The

agate jets, the greatest care is taken to make an orifice of the standard size; but very slight variations, only indicated by differences in the rate of flow of a liquid through the jet, are unavoidable, and a correction accordingly has to be made. This is effected by adjusting the position of the bracket, and therefore the length of the oil column, so that different instruments furnish concordant results.*

* The instrument, properly standardised, can be obtained of Messrs. James How & Co., 73, Farringdon Street, London.

If the jets varied greatly in respect to size of orifice, this method of correction would probably not be satisfactory, since I should then expect to find that two instruments standardised with an oil of given viscosity would not furnish concordant results with oils of much greater or much less viscosity; but the necessary amount of correction is so small that I have not in practice found that any objection attaches to the method adopted.

The instrument is supported on a tripod stand, provided with levelling screws. In the use of the apparatus, a measured quantity of oil (50cc.) is allowed to flow out. It therefore follows that in every experiment the operator starts and finishes with a column of oil of a given length; and the results may, therefore, be regarded as the average of those which would be obtained in a series of experiments, with a head of oil maintained at any number of points between the starting and finishing points. Mr. Alfred H. Allen, who has one of these viscometers in use, has, however, fitted to the top of the oil cylinder an air-tight cap, carrying a tube passing down to a point some little distance from the bottom of the cylinder, and is in this way enabled to maintain a given head of oil throughout the experiment. I have not myself experienced the need of this modification, but it may obviously be of value in certain cases, since with its adoption any given quantity of the liquid, however small, flowing out in a given time, may be taken as the measure of the viscosity, and a considerable saving of time in the testing of a viscous oil may be effected. Mr. Allen informs me that he finds the results afforded by the instrument in its original and modified forms strictly comparable.

The instrument is employed in the following manner:—The bath is filled with a suitable liquid to a height roughly corresponding with the point of the gauge in the oil-cup. Water answers well for temperatures up to 200° F., and for higher temperatures a heavy mineral oil may be used. The liquid having been brought to the required temperature, the oil to be tested previously brought to the same temperature, is poured into the inner cylinder, until the level of the liquid just reaches the point of the gauge. A narrow-necked flask, holding 50cc. to a point marked on the neck, is placed beneath the jet in a vessel containing a liquid of the same temperature as the oil. The ball valve is then raised, a stop-watch at the same time started, and the number of seconds occupied in the outflow of 50cc. noted. It is of the greatest importance that the oil cylinder should be filled exactly to the point of the gauge, and that the given temperature should be precisely maintained during the experiment, a difference of $\frac{1}{2}$ ° F. making an appreciable alteration in the viscosity of some oils. It is also essential that the oil should be quite free from dirt or other suspended matter, and from globules of water, as the jet may be otherwise partially obstructed. If the oil cylinder requires to be wiped out, paper rather than cloth should be employed, as filaments of the latter may be left adhering. When oils are being tested at temperatures much above that of the laboratory, a gas flame is applied to the copper heating tube, and the agitator kept in gentle motion throughout the experiment. At least two tests of each oil at the given temperature should be made, and if due care is exercised, the two results will be very closely concordant. In the testing of oils for the lubrication of the bearings of machinery exposed to the air, I am accustomed to determine the viscosity at the two temperatures of 70° F. and 140° F. But in the case of cylinder oils, I make the tests at 200° F. and

250° F., though with the apparatus described, viscosities can easily be determined at 300° F., or even a higher temperature. The method in which the results should be expressed admits of a good deal of discussion. In some instances it has been customary to report the number of seconds occupied in the outflow of a given quantity as the viscosity, and since there has been no recognised method of operating, the results furnished by different experts have not been in any way comparable. Water has been taken by some, and rape oil by others, as a standard liquid, and the results have been expressed in terms of the standard liquid. Water, however, possesses too little viscosity to render it a satisfactory liquid to compare a lubricating oil with, and rape oil is not of sufficiently uniform viscosity. Mr. Charles Rumble has made a number of experiments with the object of finding a suitable liquid, and has obtained the best results with glycerine of specified specific gravity. It appears to me, however, that if a certain viscosity of rape oil, as determined in the manner described, be accepted as the standard, the admittedly variable viscosity of this oil need be no bar to the adoption of rape oil as a standard, and there is a great advantage in expressing the results in terms of a liquid of well known viscosity. I have accordingly tested, with the assistance of Mr. E. Ivens Moon, a considerable number of samples of refined rape oil, with the view of ascertaining what may be considered the average viscosity of such oil. For these samples I am indebted to Mr. Edmund Dowling (Pinchin, Johnson & Co.), Mr. J. A. Fermoy, Mr. Hirsch (Copenhagen Oil Mills), Sir W. A. Rose & Co., and Messrs. Younghusband, Barnes & Co. I am of opinion, as the result of these tests, that 535, representing the number of seconds occupied by the outflow of 50cc., may be accepted as the viscosity of refined rape oil at 60° F. I may add that the viscosity of water is, under similar circumstances, 25.5. I therefore propose that the number of seconds occupied in the outflow of 50cc. of the oil under examination, should in all cases be multiplied by 100 and divided by 535. In order then to make the requisite correction for specific gravity, the result should be multiplied by the specific gravity of the oil under examination at the temperature of the experiment, and divided by 915 (the specific gravity of refined rape oil at 60° F.); the final result will thus represent the viscosity of the oil at the temperature of the experiment, as compared with that of rape oil at 60° F. I have had some doubt whether the viscosity should not be expressed in terms of rape oil (as regards viscosity and specific gravity) at the temperature of the experiment, but it is obviously much simpler and more convenient to base all results upon the viscosity and specific gravity of rape oil at 60°, and if this view is generally accepted I do not see that any practical inconvenience can arise.

The viscosity of all oils, and especially of mineral oils, is largely affected by change of temperature, and the extent to which this occurs is a point of so much importance in regard to the value of the oils as lubricants in certain cases, that determinations of viscosity should always be made at two temperatures tolerably widely separated. The variation in the extent to which different oils are affected in viscosity by changes of temperature is shown in the table of results, which I have obtained with sperm oil, refined rape oil, neatsfoot oil, and several descriptions of American and Russian mineral lubricating oils (Fig. 6). The curves which these figures form when plotted show very clearly how comparatively little sperm oil alters in viscosity, and I think that the admitted value of

this oil as a lubricant for use under very varied conditions may be largely due to the fact that the loss of viscosity on a rise of temperature is so small. I have on a previous occasion in this room remarked upon the well-known fact that Russian oils lose viscosity upon an elevation of temperature more rapidly than American oils of the same specific gravity; but I took occasion at the time to point out that with both classes of oils the diminution of viscosity is greatest

ing may vary considerably, it is evidently desirable to give the preference to an oil which varies least in viscosity within the limits of temperature to which it is likely to be subjected.

Addendum.—After the foregoing paper was handed in, Mr. Ernest G. von Glehn, of the firm of Ragosine & Co., manufacturers of Russian mineral lubricating oils, was good enough to call my attention

VISCOSITY.—SECONDS FOR 50°C.

Temperature Fahr.	1	2	3	4	5	6	7	8	9	10	11
50	—	712½	—	620	—	115	125	1030	2010	2520	—
60	25½	510	177	170	—	105	295½	680	1235	1980	—
70	—	405	136½	366	—	90	225	485	820	1320	—
80	—	326	113	280	—	73	171	375	580	900	—
90	—	260	96	219½	—	63½	136	262	426	640	—
100	—	213½	80½	174½	—	51	111	200	315	410	1015
110	—	169	70½	147½	—	50	89½	153	226	335	739½
120	—	147	60½	126	—	47	78	126	174	245	531
130	—	123½	57	112	—	44½	63½	101	135½	185	398½
140	—	105½	50½	88½	—	41	53	82	116	145	317½
150	—	95½	49	75½	—	37½	52	70½	95	115	250
160	—	85	47½	70	—	—	46	63½	83½	93½	200
170	—	76	46	62	—	—	—	58	70½	77½	161
180	—	69	44½	55½	—	—	—	52½	61½	67½	134½
190	—	64½	43	53	—	—	—	47	56½	61	115½
200	—	58½	42	50½	54½	—	—	42	48½	51	99½
210	—	51	40½	48½	—	—	—	40	—	—	85
220	—	50	39	47	—	—	—	38	—	—	77
230	—	47½	36½	45½	—	—	—	—	—	—	70½
240	—	45½	35½	44½	—	—	—	—	—	—	64½
250	—	43½	34½	44	40	—	—	—	—	—	59½
260	—	Viscosity slightly above the average.	33½	43½	—	—	—	—	—	—	51
270	—		32½	43	—	—	—	—	—	—	48½
280	—		31½	41½	—	—	—	—	—	—	46½
290	—		30½	41	—	—	—	—	—	—	44½
300	—		30	38	—	—	—	—	—	—	42½
310	—		—	35	—	—	—	—	—	—	—
320	—		—	33½	—	—	—	—	—	—	—

- 1—Water. 6—American mineral oil, sp. gr. '885.
 2—Refined rape oil. 7— " " " " '913.
 3—Sperm oil. 8— " " " " '923.
 4—Neatsfoot oil. 9—Russian " " " " '909.
 5—Beef tallow. 10— " " " " '915.
 11—Russian mineral oil, sp. gr. '881 (semi-solid at common temperatures).

in the cases of the most viscous, and since the Russian oils of a given specific gravity are more viscous than the American, one would expect to find the loss in viscosity greater. In the selection or in the valuation of a lubricating oil, it seems to me that one should, if possible, ascertain the temperature at which the oil is to be used, and determine the viscosity at that temperature. If then the viscosity of an oil which has given satisfactory results under the circumstances of the case be known, a very good opinion may be formed as to the comparative value or suitability of the oil under examination. Since, however, it is impossible in a mill, for instance, to have in use the large number of different oils which would be required if this principle were strictly carried out; and since the temperature of a given bear-

ing may vary considerably, it is evidently desirable to give the preference to an oil which varies least in viscosity within the limits of temperature to which it is likely to be subjected.

to a paper by M. Salomon,* published in the *Revue Générale des Chemins de Fer*, last year, wherein an apparatus devised by M. L. Barbet, sous-chef du Laboratoire du service du Matériel et de la Traction de la Compagnie de l'Est, for testing viscosity, is described. In this apparatus, which is termed an Ixomètre, the oil under examination is caused to flow through an annular space formed by fixing an iron rod 4mm. in diameter precisely in the centre of a brass tube 5mm. in internal diameter. Increased resistance to the flow of the liquid is thus created, and it is stated

* "Note sur l'emploi comparé des huiles de colza et des huiles minérales de Pechelbrunn et du Caucaise pour le graissage du matériel roulant." Par M. Louis Salomon, ingénieur du matériel roulant de la Compagnie des Chemins de Fer de l'Est. Paris.

that the apparatus is more sensitive than an ordinary jet viscosimeter, and gives results with oils of various viscosities differing more widely than those usually obtained.

Note.—Mr. Tyrer has placed in my hands the following written comments by Mr. Maxwell Lyte, who was unable to be present at the reading of the paper:—"The apparatus described by Mr. Redwood seems extremely ingenious, so far as its description

grease or the denser petroleum oils or rosin oils, mixed with tale or plumbago. Such an apparatus will hardly do as it is for testing such lubricants, and will have to be modified somewhat for the purpose."

In reference to these remarks, I have to say that possibly a paddle-wheel viscometer might be constructed for the testing of such greases; but I am very doubtful whether any test, other than that of using the grease under the conditions of actual prac-

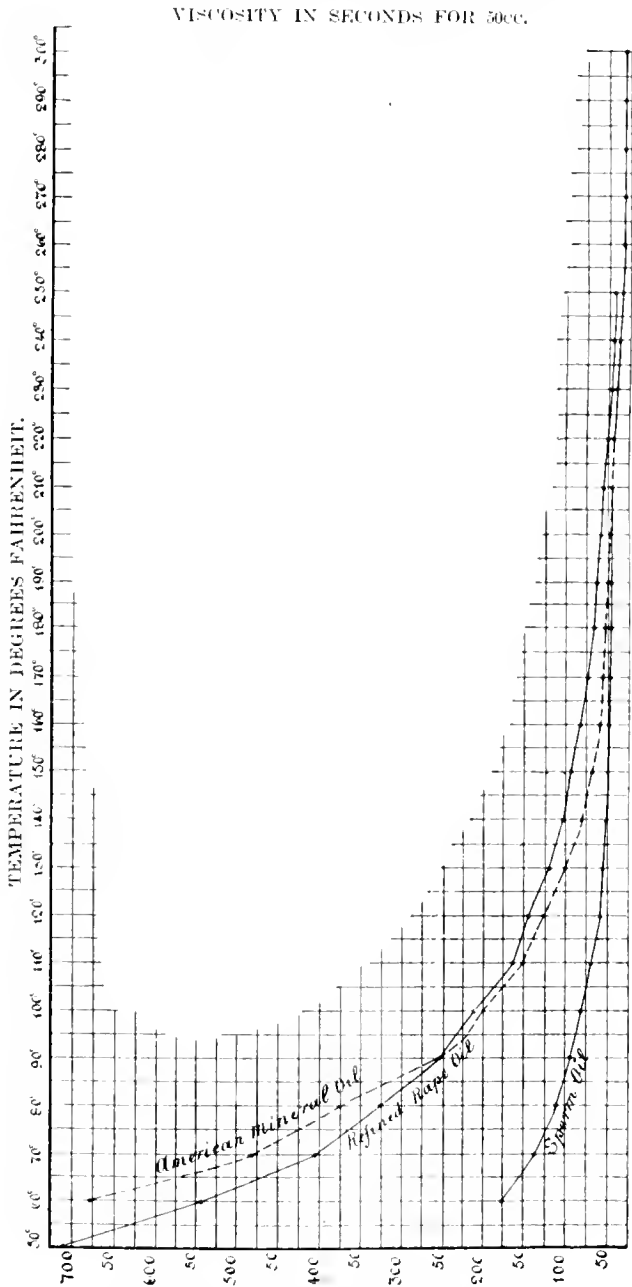


FIG. 4

can be followed without illustration, and it must well answer the purpose for which it is intended. It is, however, much to be desired that a good testing apparatus should be found for the cheap solid lubricants more and more coming into use, especially on the Continent, for heavy machinery, and made from

tice, could be relied upon, unless it were found, as the result of a sufficiently extended series of experiments, that there was a similar relation between the viscosity (tested in the manner suggested) and the lubricating power of such compound greases, to that which has been shown to exist in the case of oils.

DISCUSSION.

The CHAIRMAN said this was a subject of very great interest, both as a question of abstract science involving the relation of the physical properties of these bodies, whose constitution was very little understood, and as a practical question to all who had to do with running machinery. Very little had yet been

Still it would be an immense advantage if science could afford them more accurate information.

Mr. RUMBLE said it was his intention to endeavour to make a standard fluid with glycerine, but considers able doubts were thrown on its suitability, and there was a question whether glycerine from all sources had the same characteristics. The main use of gly-

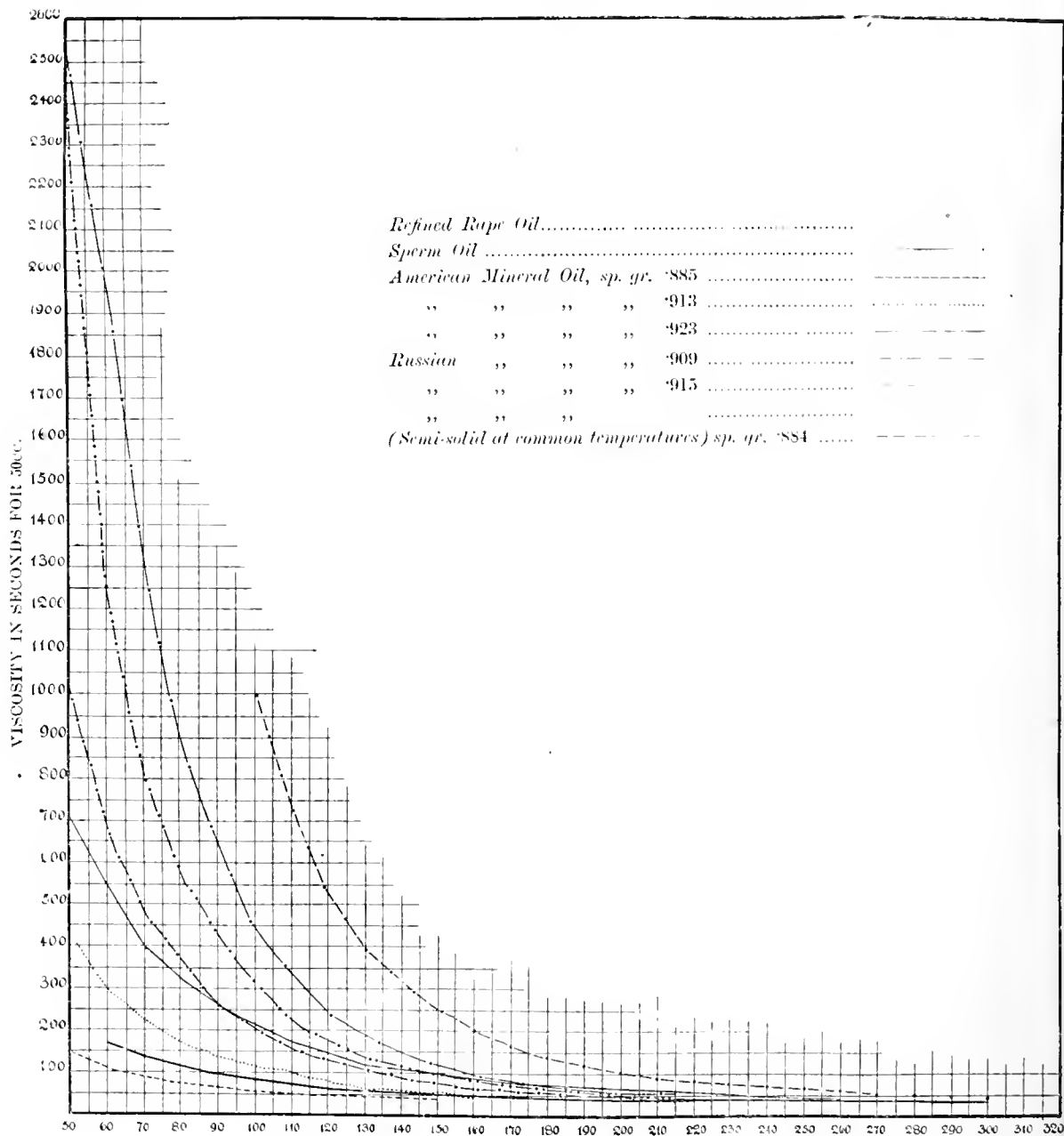


FIG. 5.—TEMPERATURE IN DEGREES FAHRENHEIT.

done in it. For the most part they had to trust to the skill of an intelligent workman to decide which were the best lubricating oils, and it was wonderful how much tact and skill a workman would acquire, and how rapidly he would perceive whether a bearing was working properly, and how accurate a thermometer a finger properly applied to a bearing was.

cerine to him was that it enabled him to standardise certain flasks which were used for measuring the flow of oil. Like many others, he had found that a glass pipette was a very unsatisfactory instrument; that you could not make two alike; that when one was gone your standard became a very different one for the future, and, therefore, you could not compare

present results with past. He used a much larger flask than Mr. Redwood, because with some of the liquids he had to test, the time, even with a larger instrument, was very short, and there would be danger of inaccuracy with too small a quantity. The standard he adopted was of the same capacity as 1614 grains of water at 70° F.

Mr. CALDERWOOD had listened with great interest to this communication, the question being one of great importance to merchants, manufacturers, and consumers. He suggested that the section should appoint a committee to confer with a committee say of the Glasgow section, and possibly of the Manchester section, and endeavour to agree on a standard. Personally he was in favour of rape oil as a standard, but perhaps he was not quite unbiassed, having been accustomed to use it for 15 years.

Mr. A. H. ALLEN (Sheffield) said he had not only listened to the paper with very great pleasure, but he agreed with Mr. Redwood in nearly everything he had advanced. He had been in the habit of using one of Mr. Redwood's instruments for determining viscosities, and was fully alive to its convenience and value. He had, however, somewhat modified it, because he often wanted to determine the viscosity, not to ascertain the lubricating value, but as a test for a particular animal or vegetable oil. For such purposes, the apparatus shown was often tedious, for he did not find, as Mr. Rumble did, that

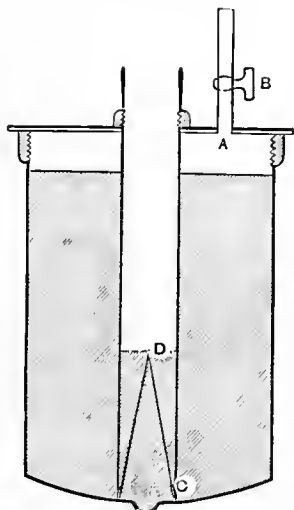


FIG. 6.

the oil flowed too quickly, but that it ran through too slowly, and one got very tired of watching it, and keeping the temperature constant. He, therefore, used an arrangement by which the oil was kept at the same level throughout the experiment. This was effected by fitting an air-tight cover to the oil cylinder, as shown in Fig. 6. The cover is perforated by two holes, one of which, A, is furnished with a tap, B, while the other was fitted with a tube screwing air-tight into it. This tube, C, is prolonged on two sides till it is in contact with the agate orifice, while the angles of the inverted V-shaped slits cut on each side terminate at a definite height above the orifice. The cylinder is completely filled with oil before commencing an experiment, the tap B closed, and the orifice opened till the oil sinks in the inner tube to the level of D. Air then bubbles in regularly at D and rises into the closed space above the oil. When this is observed to happen the oil is collected as usual. There is then a constant head

of oil, and it ran through at the same rate, instead of the first 10cc. running through at one rate, the second at a slower rate, and so on. There is no necessity, therefore, to go on until you had 50cc., because you were sure that if 10cc. took so many seconds, 50cc. would take five times as many; and you could stop the experiment when a certain weight had flowed. After all, Mr. Redwood's is an arbitrary apparatus, arbitrary as to the size of the hole drilled in the agate, the diameter of the cylinder, the height of the column of oil, and so on; and other persons not using exactly the same apparatus will get quite different results. In order for them to be concordant, everyone must use an apparatus made exactly in accord with Mr. Redwood's directions. Still, unless someone else could put forward a better apparatus, this was likely to be adopted as the standard for the future. He was not so thoroughly convinced of its advantages six months ago as he is now, and he had in fact given up some of his own ideas and adopted Mr. Redwood's. It was clear that with a metal apparatus, the diameter could be more accurately defined than in the case of glass, and an orifice drilled in agate would not be so likely to vary by corrosion as if it were in metal. He should, however, prefer the hole to be drilled in a thin plate of agate or glass, instead of a thick one; but after all, being an arbitrary apparatus, the main point is that all should be made exactly alike. He had also used an apparatus similar to the one shown with paddle-wheels, and thought it would be exceedingly useful where rapid results were required. Differences arising from specific gravity are eliminated, and when once set going it is quite constant. He congratulated Mr. Redwood on having overcome the difficulty of keeping the oil at a constant temperature by keeping it stirred, but thought the apparatus would be improved by a cover at the top to keep in the heat. He also thought he was right in adopting rape oil as the standard, though he was inclined to think a good standard might be obtained from glycerine. Pure glycerine is easily obtained, and it might be diluted to a certain density at which its viscosity was equal to that of rape oil of average quality. Such a standard glycerine would be more definite, probably, than rape oil, and could be reproduced at will, and might, therefore, be used as a means of testing the accuracy of the apparatus. Still, for practical purposes rape oil would probably be preferable, being so familiar to persons dealing in oils. He saw no objection either to taking rape oil at 60° F., though in some respects it would be preferable to take it at the same temperature as the oil to be tested. He agreed with Mr. Redwood as to the probable reason why sperm oil was so good a lubricant under so many varying conditions. For his own purposes he should prefer to take the viscosity at ordinary temperatures, rather than at elevated temperatures. Castor oil was many times as viscous as sperm oil at ordinary temperatures, but if the temperature were raised, so as to make it run through the aperture in a reasonable time, it lost the very property which was so characteristic of it.

Mr. ARCHBUTT said it appeared to him that if a scientifically accurate result were required, water, or a mixture of glycerine and water of definite specific gravity, would be a better standard than rape oil; but such absolute accuracy was not necessary, and, as had been already pointed out, it would be difficult to persuade commercial men to adopt any standard but rape oil, which had been in use for a long time. Rape oil, however, varied a good deal. He had made a number of experiments with an apparatus of the old form, but specially constructed so as keep the temperature absolutely constant, and he found the viscosity

varied from 100 to 109, whilst one or two samples went as high as 127 on the same scale. These samples were all genuine by chemical tests, and he supposed the oil which gave the high result to be summer rape, which is said to be more viscous than winter rape. If rape oil were adopted as a standard, it would be desirable to state whether summer or winter rape was intended. Again, rape oil was often mixed with other oils, and a small proportion of linseed would reduce the viscosity considerably. So that unless some reliable test for rape oil were supplied, it seemed almost impossible for every one to be able to standardise his own apparatus, which he thought very desirable. He quite agreed with the necessity for the adoption of some standard, but he thought the subject required fuller consideration. He also considered it better in all cases to compare the viscosity of an oil with that of the standard at the *same* temperature.

Mr. FORMOY said he had found great difficulty in getting a standard rape oil; the only way it was possible was to crush hand-picked seed, grown in a certain district at 60° F., and refine it exactly. A standard oil was thus produced, the viscosity of which varied but little. He had employed an apparatus somewhat similar to Mr. Redwood's for some time, but the cylinder was greatly elongated, and he used varying columns of oil according to the specific gravity; the quantity passing through in a given time being measured. Mr. Redwood proposed to compare the viscosities of various oils at different temperatures to a certain standard of rape oil at 60°; he found it necessary to compare the various oils at the temperature at which they were to be used.

Mr. JOHNSON said he should like Mr. Redwood to define what he meant by the term viscosity, and if he had determined the influence of different materials forming the vessels or apertures through which the different fluids flowed on the results obtained. He imagined it would be a very different question using an iron nozzle with mercury flowing through it, whether the nozzle were amalgamated or not; this effect of surface attraction would apply to all the forms of apparatus for determining viscosity shown with the exception of the wheel arrangement, that was evidently a determination of the degree of adhesiveness of the oil for the oil itself; the wheel collected a film of oil on its surface, and the adhesion between the film of oil on the wheel and that in the vessel was really what was determined. This was a question which ought to be determined scientifically and accurately, and unless this were done the results would be discordant. It was evident that the adhesion of the various oils under consideration would be very different with nozzles of glass, agate, iron or other metals. He thought care should be taken that the measure of viscosity should not be accepted as a means of comparison between oils of different kinds in respect to their value as lubricants, as this would be altogether wrong and misleading.

Mr. MACTEAR thought the subject ought to be further discussed. It seemed to him in any form of apparatus of that kind, if the jets varied the whole of the results would vary. If such an instrument were to be adopted at all there must be a standard instrument, from which all others should be calibrated. Rape oil would probably be adopted as the standard, but the comparison would probably require to be given at various temperatures, such as 60°, 100°, 200°, and 212°.

Mr. T. TYLER said there were several sections in the North and Midlands where this question would be of great importance, and he might write to the secretaries suggesting that the subject should be discussed, with a view to a committee being afterwards appointed to consider it.

Prof. ARMSTRONG thought the subject was hardly yet before them in such a form as to justify any very definite action being taken. Mr. Redwood had read a very interesting and important communication, but it was a subject of which comparatively few had any experience, and, unless a very influential committee were appointed capable of dealing with the subject, both from the practical and scientific point of view, and authorised to carry out a number of experiments, the result could only be, either that Mr. Redwood's apparatus would be adopted as the standard apparatus or it would not. He could not help thinking the better plan would be to let Mr. Redwood's paper stand on its own merits; anything he brought forward would of course receive the most serious attention, but there were also very important experiments which had been carried out by Mr. B. Tower, for the Mechanical Engineers, which had resulted in former views being very much modified, and unless they could take some concerted action with other bodies they might easily do more harm than good.

Mr. REDWOOD, in reply, said that his object had been to evoke a discussion which might lead ultimately to something like unanimity of opinion on this important question. He was not wedded to any particular instrument, but found that he could obtain with the apparatus he had described as being in use in his laboratory, better results than with any other he had tried. With regard to Mr. Johnson's suggestion that experiments should be made with jets of different materials, he would say that it was clearly recognised that the results afforded by all the various forms of viscosimeters were purely arbitrary, and accordingly when he spoke of an oil as having a viscosity of 50 at a given temperature, what he meant was simply that when tested in his apparatus the prescribed quantity would flow out in half the length of time occupied by average refined rape oil at 60° F., irrespective of differences due to density. An estimate of the comparative value of different oils for use as lubricants under given conditions could thus be formed. The relation of viscosity to lubricating power was a question which could only be determined by the light of practical experience, but he had quoted authorities, who were certainly unbiassed and possessed practical knowledge of the subject, in support of the view that there was a very close relation between the two characteristics.

Mr. JOHNSON asked whether this was so as between mineral oils and vegetable oils?

Mr. REDWOOD said it undoubtedly applied as between mineral oils of different densities, and to a certain extent as between mineral oils and fixed oils. As he had, however, pointed out, the principles of lubrication were not very well understood, and he had already referred to the case of sperm oil as showing that the viscosities of a fixed oil and a mineral oil were not necessarily true indications of their respective lubricating values. But he must remark that it was for the purpose of comparing one mineral oil with another mineral oil that a correct knowledge of the viscosity was so necessary. So long as engineers were accustomed to use fixed oils, the determination of viscosity was not very important, as the variation in this respect in the case of any given fixed oil was not great; but now that mineral oils had largely replaced fixed oils, the case was, as he had explained in his paper, altogether different. Mr. Allen had said that he would have preferred a jet made by drilling a hole through a thin plate of agate, but the difficulty of making a good joint constituted an objection to such an arrangement. Moreover, if the view of M. Barbet were accepted, it was desirable to increase rather than decrease the frictional surface, and, therefore, to act upon Mr. Allen's suggestion

would be a step in the wrong direction. In conclusion, he trusted that the proposal of Mr. Calderwood would be adopted, and that some step would be taken to bring about concerted action in the matter.

Meeting held Monday, March 17, 1886.

PROF. H. E. ARMSTRONG, F.R.S., IN THE CHAIR.

ICE-MAKING AND COOLING MACHINERY.

BY T. B. LIGHTFOOT, M.I.C.E., M.I.M.E.

PUTTING aside all considerations respecting the direct use of natural ice, a process which for economical reasons must ultimately give way to mechanical means, except in certain special cases, which need not be entered upon here, it may be stated that the function of all refrigerating apparatus, which work continuously, is to absorb heat at a low temperature, and reject it at a comparatively high temperature; heat energy, the amount of which is the measure of the thermal efficiency, and to a large extent of the commercial efficiency of the apparatus, having to be expended in order to enable the refrigerating or heat-absorbing medium to part with its acquired heat to bodies at normal temperature. If the absorbed heat be not thus disposed of, it is obvious that one of two things must take place—viz., either the refrigerating medium itself must be rejected, and renewed, or equalisation of temperature would ensue, and the functions of the apparatus cease.

Refrigerating machinery may be divided into three classes, depending on the properties of the heat-absorbing agents employed in them. These are—

I. Apparatus and machines in which heat is absorbed by the evaporation of a more or less volatile liquid.

II. Machines in which a gas is cooled by allowing it to expand while performing mechanical work, and is afterwards used for abstracting heat.

III. Apparatus in which heat is abstracted by the rapid liquefaction of a solid.

It will be convenient to deal with each of these classes separately.

CLASS I.—HEAT ABSTRACTED BY EVAPORATION.

Whatever be the temperature at which a liquid is vapourised, absorption of heat must take place—this, as is well known, being due to an alteration in molecular motion, which accompanies the change in physical state. The amount of heat thus acquired varies for different bodies, and varies slightly for the same body according to the pressure at which vapourisation occurs. Among other properties, this exercises an important bearing on the fitness of any particular liquid for use as a refrigerating agent. For, other things being equal, it is obvious that the greater the heat of vapourisation, the smaller the weight of liquid that must be evaporated in a given time to produce a given cooling effect, and consequently the less the energy that must be expended in order to bring the agent into a condition to enable the heat to be rejected.

The greatest amount of heat is absorbed by water, one pound of which, in changing to the state of vapour at ordinary atmospheric pressure, requires the addition of 965.7, or, say 966 thermal units. Were this the only point to be considered in the selection of a refrigerating agent, water, by reason of this high latent heat, as well as from its plentifulness, would undoubtedly be the most suitable material. But the facility with which a

liquid can be vapourised, and again liquefied under such conditions as are convenient in practice, its effect upon the materials employed in construction, its inflammability, its stability, and lastly its cost, are of equal importance; and it will be at once seen in regard to water, whose vapour tension at freezing point is only 0.088 of a pound per square inch, that its use would necessitate the maintenance of a much more perfect vacuum than can be attained with air-pumps of ordinary construction. The vapour tensions of various liquids ordinarily used for refrigerating purposes are shown graphically in Fig. 1.

The earliest system of ice making by evaporation, is that which is still practised in some of the upper provinces of India. Water is placed in shallow pans of unglazed porous earthenware, about 1½ inches deep, which are laid in pits about 2 feet in depth, partially filled with straw, and exposed in the open air at night when the atmosphere is clear and dry. Under such conditions, heat is rapidly radiated; and this, combined with the loss of heat from evaporation—which, owing to the insulation of the dry straw, can only be acquired from the water itself—so reduces the temperature that a thin film of ice is formed on the surface. The same effect was produced by Dr. Cullen in 1755, by the use of an air-pump, while in 1810 the discoveries of Leslie resulted in the construction of an apparatus, in which from 1 to 1½ pounds of ice could be made by the rapid evaporation caused by the action of a vacuum pump, in conjunction with strong sulphuric acid, for absorbing the vapour. By reducing the pressure, water was caused to boil, and as the vapour was taken up by the acid as quickly as it was formed, a rapid evaporation was produced, which ultimately effected the freezing of the water.

Vallance and Kingsford followed on the same lines, but produced no practical results; and Carré, also, many years later, brought out an apparatus for cooling liquids and making small quantities of ice for domestic purposes, in which the same principles were embodied.

In 1878, Franz Windhausen, of Berlin, who for many years had paid attention to refrigerating apparatus, patented a compound vacuum pump, by which he proposed to produce ice direct from water on a large scale, without the employment of sulphuric acid. In the same specification he described an arrangement in which sulphuric acid could be used, the acid being cooled by water during its absorption of the vapour, and afterwards concentrated, so that a fresh supply was rendered unnecessary. In 1880, this apparatus was further developed, and fresh patents taken out, and in 1881 a machine of a nominal ice-producing capacity of 15 tons per 24 hours was put to work on the premises of the Aylesbury Dairy Co., at Bayswater, being afterwards removed to Lillie Bridge, where it now is. This installation was fully described and illustrated by Carl Pieper in a paper read before the Society of Engineers in November, 1882, and by Dr. Hopkinson at the Society of Arts about the same time.

As in order to form 1 pound of ice at 32° F. from 1 pound of water at 60°, 170 thermal units must be abstracted, 1 ton of ice will require the abstraction of 380,800 units; therefore, assuming that the whole of the cooling work is done on the water, and that only vapour passes off, it is obvious that 349 pounds of water must be evaporated to make 1 ton of ice. In addition to this, however, there would be an extra amount for taking off the sensible heat of the evaporated water itself, which, entering at 60°, would pass away at 32°. According to statements made by Mr. Pieper, the total water used in Windhausen's apparatus is about 12 times the weight of ice produced, including what is required for cooling purposes.

CURVES OF VAPOUR TENSIONS

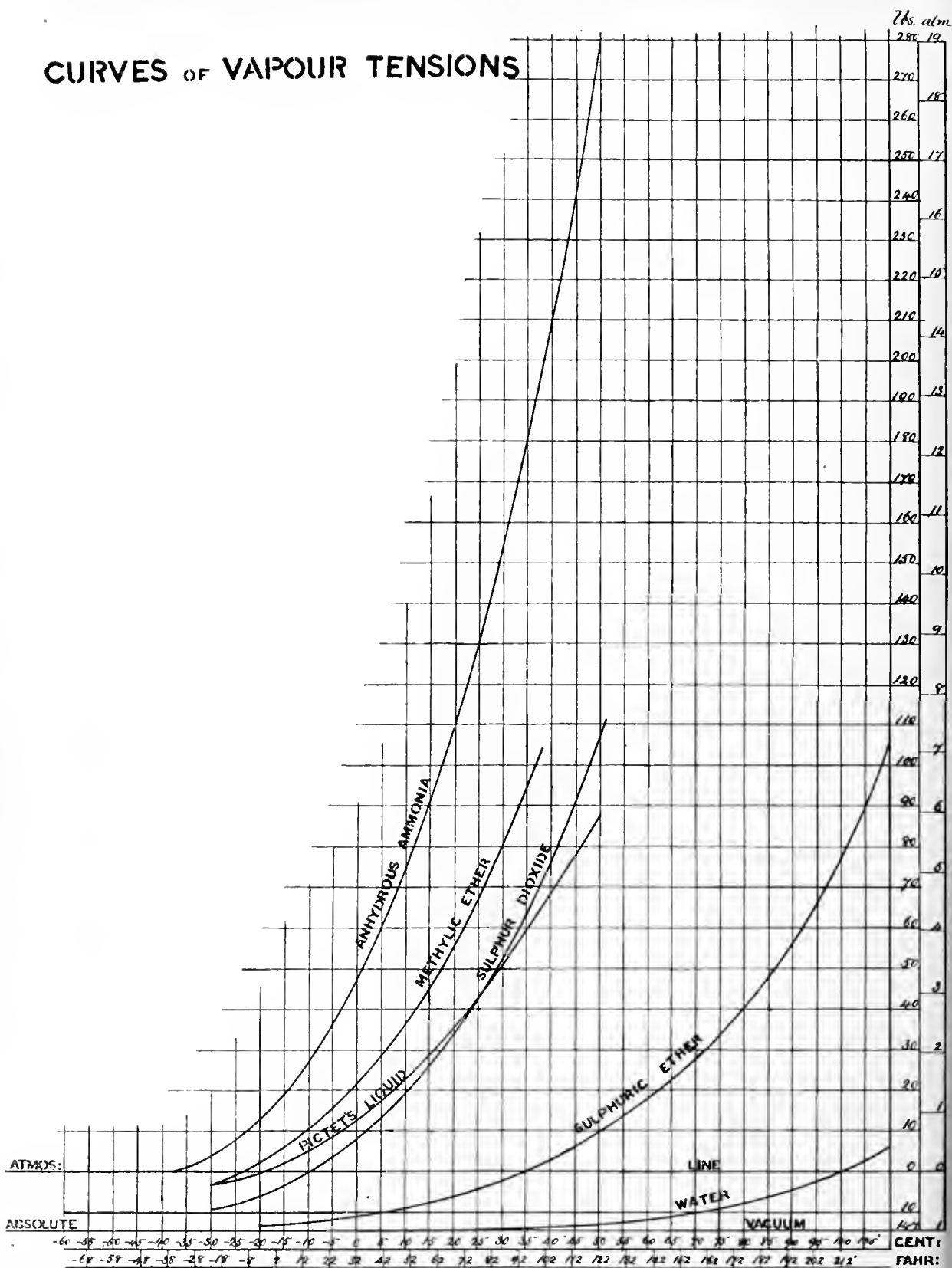


FIG. 1.--6½ INCHES.

Fuel is consumed in driving the vacuum pumps, in evaporating the absorbed water from the weak acid in the concentrator, and in driving the concentrator air-pump. The coal consumption is given at 180 pounds per ton of ice produced; but in actual work I believe this amount is considerably exceeded. Altogether the total cost of making 1 ton of opaque ice has been stated at four shillings, but this figure was arrived at when the plant was new, and when everything was, therefore, in perfect order, and I should not be surprised to learn that the cost, including a proper amount for wear and tear, very much exceeds this sum.

In addition to the machine at Lillie Bridge, others have been erected in London, but Windhausen's process has so far not met with any extended application in this country, owing no doubt to the opaque and porous condition of the ice produced, as well as to the cumbrous nature of the plant, which, with its large and delicate pumps, and the acid-concentrating apparatus, must require considerable supervision and care in working. It has been proposed to apply the machine to the cooling of brine by evaporation, the brine being afterwards used for refrigerating purposes or for making ice on the ordinary system with open moulds. The cost, however, would, in this case, be much increased, and greatly exceed that by other processes.

In 1878, James Harrison patented an improved vacuum apparatus for refrigerating liquids by their own partial evaporation, and for making ice. One form of vacuum pump proposed by Harrison is shown

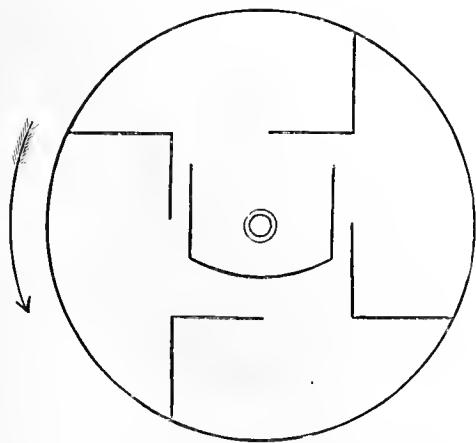


FIG. 2.—SECTION OF HARRISON'S PUMP.

in section in Fig. 2. It consists of a horizontal revolving cylinder of iron, divided into compartments, which is partially filled with a non-evaporable liquid, or one which evaporates only at a temperature considerably in excess of that at which the refrigerating liquid is evaporated, and which is also chemically neutral to the vapour with which it is brought in contact. The refrigerating or ice-forming vessel from which the vapour is to be withdrawn is connected by a pipe with one end of a fixed hollow axle, on which the cylinder revolves, a continuation of the pipe rising up inside above the level of the liquid, the partitions being stopped short at one end to enable this to be done. The cylinder is rotated, so that the compartments move round mouth downwards, carrying with them the vapour with which they are charged, and compressing it to an extent measured by the distance they dip below the surface of the liquid, until, when the compartment approaches the lowest position, the compressed vapour is liberated, and rises

into a fixed hood or casing in communication with a second hollow axle on the opposite side of the cylinder to that on which the vapour enters. Through this axle the compressed vapour passes to a surface evaporative condenser, in which, by the combined action of direct cooling, and the partial evaporation of water trickling over the tubes, it is condensed, the water of condensation, along with any air, being finally discharged into the atmosphere by means of a small pump.

Mr. Harrison informs me that he can produce ice by his vacuum process on a large scale at a cost of 1 shilling per ton, but I am not aware whether this includes any allowance for depreciation and repairs. This cost, of course, applies to opaque and somewhat porous ice made by the direct evaporation of a portion of the water to be frozen. If the ice is not made direct, but is formed in moulds, subjected externally to the action of brine that has been cooled by the evaporation of a portion of its water, the cost would necessarily be greater. But the ice would then be solid and transparent, by which its value would be increased. Several attempts have been made to produce transparent ice by the direct process, but so far without success.

So far as I have been able to ascertain, the earliest suggestions to apply the continuous evaporation of a more volatile liquid than water for the production of ice and cooling of liquids was made by Vallance, in 1824. The scheme was, however, impracticable in form, and does not seem to have taken any more definite shape than the mere suggestion in the patent specification. The first really practical machine in which the continuous vaporisation and liquefaction of a volatile fluid produced the freezing or cooling of liquids was invented by Jacob Perkins, in 1834. Ether was intended to be used, but according to Sir Fred. Bramwell, the first, and I believe the only machine ever made by Perkins was put to work with a volatile liquid arising from the destructive distillation of caoutchouc. This apparatus is really the parent of all compression machines used at the present day, from which it differs indeed only in matters of constructive detail. The water to be frozen was placed in a jacketted copper pan, the jacket being partially filled with the volatile liquid, and carefully protected on the outside with non-conducting material. A pump drew off the vapour from the jacket, and delivered it compressed into a worm, around which cooling water was circulated, the pressure being such as to cause liquefaction. The liquid was collected and led back to the jacket through suitable pipes and valves to be again evaporated.

The degree of compression in such a machine is of course dependent in the temperature of the cooling water, which defines the pressure at which liquefaction will take place; and the energy expended in producing this compression, plus that due to the rise in the sensible heat of the vapour, is the measure of efficiency. Isothermal compression, even if it could be attained, is out of the question, as the temperature of the vapour must of necessity be raised above that of the cooling medium; but the less the temperature is allowed to rise above that necessary to effect the required transfer of heat, the less is the power expended. The conditions which obtain during compression in actual practice are so various that it is impossible to attempt any accurate analysis of the process which would apply generally. Excluding friction, however, the total mechanical work expended in any compression machine may be accounted for in the following way: Heat rejected during compression; heat lost by radiation and conduction after compression; heat acquired by refrigerating agent in passing through pump; work expended in discharging the

compressed vapour from the pump. Against which is to be set work done by vapour entering the pump. From this it will be seen that the condenser has not only to get rid of the heat acquired in vapourisation, but also that imparted during compression, this latter quantity being greater or less according to the vapour dealt with, and the means adopted for keeping down the temperature during the operation; while the first quantity is independent both of the kind of refrigerating agent employed, and of the nature of the compressing process.

After Jacob Perkins, no further advances seem to have been made with this class of refrigerating machine until the years 1856 and 1857, when James Harrison, whose name has already been mentioned in connection with the vacuum process, procured letters patent in this country for an apparatus of somewhat similar description to that of Perkins, but which was worked out on a larger and more practical scale. The manufacture of this apparatus was taken up by the late Mr. Siebe, whose successors, Messrs. Siebe, Gorman & Co., still construct an improved machine on Harrison's type. Fig. 3 shows one of these machines applied to the making of ice. Ether of 720 specific gravity is

second place it is found that the lower the temperature the greater are the unavoidable losses from conduction of heat and other causes. In practice, when cooling brine for ice-making, the refrigerator is worked at a vacuum of about 25 in. of mercury, which is equivalent to a boiling point of about 10° above zero F. The condenser is made in various ways. In the present case it consists of a cluster of copper tubes placed in a wood tank, through which cooling water is circulated, the tubes being fixed into distributing boxes at each end. With the cooling water available in this country, liquefaction generally occurs at a pressure of about 3 lb. per square inch above the atmosphere, but in a warm climate it may reach as much as 10 or even 12 pounds.

In the apparatus shown on the diagram the ice is made on what is known as the can or mould system, in which moulds of sheet copper or steel, suspended in a tank, are filled with the water to be frozen, and cooled externally by the circulation of brine, the moulds being removed in order to discharge the ice as soon as it is formed.

Another method is known as the cell system. In it there are no loose moulds, but the cold brine from the

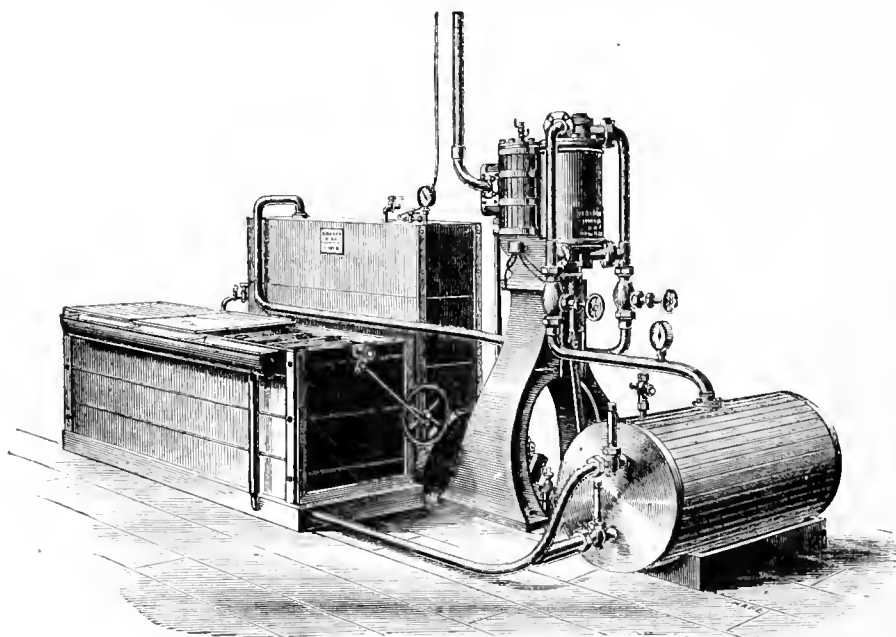


FIG. 3.

the refrigerating liquid used, its latent heat of vaporisation being 165. The refrigerator is a copper vessel containing a number of solid drawn copper tubes through which the brine passes. The vessel itself is connected to the pump by suitable pipes and valves, a smaller pipe and valve admitting the liquid ether from the condenser, the valve being so adjusted as to pass the precise quantity of ether that the pump will draw off in the form of vapour at the required working pressure. This pressure it is of course necessary to regulate so as to reduce the boiling point to the degree requisite for cooling the brine to the proper temperature. The lower the temperature to which it is desired to reduce the brine, the more perfect must the vacuum be; at the same time, so long as the brine is cooled sufficiently, it is more advantageous to work at a high pressure than a low one, for in the first place the vapour is denser, and each stroke of the pump will draw off a greater weight, and therefore produce a greater abstraction of heat, and in the

refrigerator is passed through cellular walls placed some 16 inches apart, the space between each pair of cells being filled with the water to be frozen. The ice forms on the sides of the cells and gradually increases in thickness till the two opposing layers meet and join together into one large block. If desired, however, freezing may be stopped at any time before junction occurs, and the ice removed in thinner blocks. In order to produce transparent ice it is necessary that the water should be agitated during freezing, so as to permit the air set free to escape. When moulds are used this is generally done by means of arms having a vertical or horizontal movement. With cells, agitation is generally effected from the bottom. The cost of producing transparent block ice in this country on the ether system may be taken at about 6s. per ton, with good coals at 15s. a-ton, with a well-designed machine of not less than 15 tons capacity per 24 hours, driven by a compound condensing steam engine. This is

exclusive of any allowance for repairs and depreciation.

For cooling water and other liquids, ice boxes are dispensed with, the water being passed through the refrigerator and cooled direct without the intervention of brine.

Machines of somewhat similar design have been used by Tellier with methylic ether, and by Pietet with sulphur dioxide. For certain practical reasons they have never been much introduced in this country. The cost of making ice may be taken at about the same as with ether.

I will now pass to those machines in which ammonia is employed. In 1860 Carré, taking advantage of the fact that ordinary liquid ammonia, when heated, gives off an almost anhydrous vapour which was absorbed again when the temperature was reduced, brought out a simple form of ice-making apparatus, intended chiefly for domestic purposes. This apparatus consisted of two iron vessels connected at the top by a pipe. In one vessel ordinary liquid ammonia of about 7880 specific gravity was put, and to this heat was applied. The other vessel was immersed in a basin of cold water. As soon as the temperature had risen high enough to produce the required pressure, liquefaction took place in the second vessel, the evaporation being continued until sufficient ammonia, which was necessarily mixed with a certain proportion of watery vapour, had passed over. The heat was then removed, a basin of cold water being substituted for that which had been used for condensing, and which was consequently considerably heated, while cold water was applied to the vessel that had been previously heated. The action was therefore reversed. The weak liquor

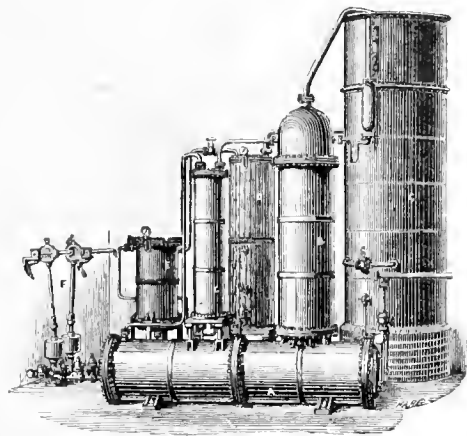


FIG. 4.

from which ammonia had been driven re-absorbed it with great rapidity as its temperature was lowered, producing very rapid evaporation from the strong liquor in the second vessel, the abstraction of heat being so great that the surrounding water was converted into ice. This is the simplest form of ammonia ice apparatus. The principle was embodied by Carré in large machines, which was afterwards improved upon by Reece, and then by Stanley, whose object was to obtain a distillate of anhydrous liquid ammonia, in order to render the working continuous, and to avoid the loss of effect caused by having a quantity of water to evaporate and cool down uselessly. This was in a great degree accomplished. Pontifex and Wood introduced still further improvements, and have succeeded in bringing the absorption machine to a high state of efficiency. Their apparatus, as applied to the cooling of liquids, is shown in

Fig. 4. It consists of eight essential parts, connected together by suitable pipes and valves. These are, an ordinary boiler for generating steam (not shown in the diagram), the generator A, analyser B, condenser and rectifier C, refrigerator or cooler D, absorber E, strong liquor pumps F, and economiser G. Besides these, if the machine is applied to the manufacture of ice, there would have to be added a brine pump, with the necessary ice-making tanks; but as these are precisely similar to those described in connection with the ether machine, it will be unnecessary to refer to them further.

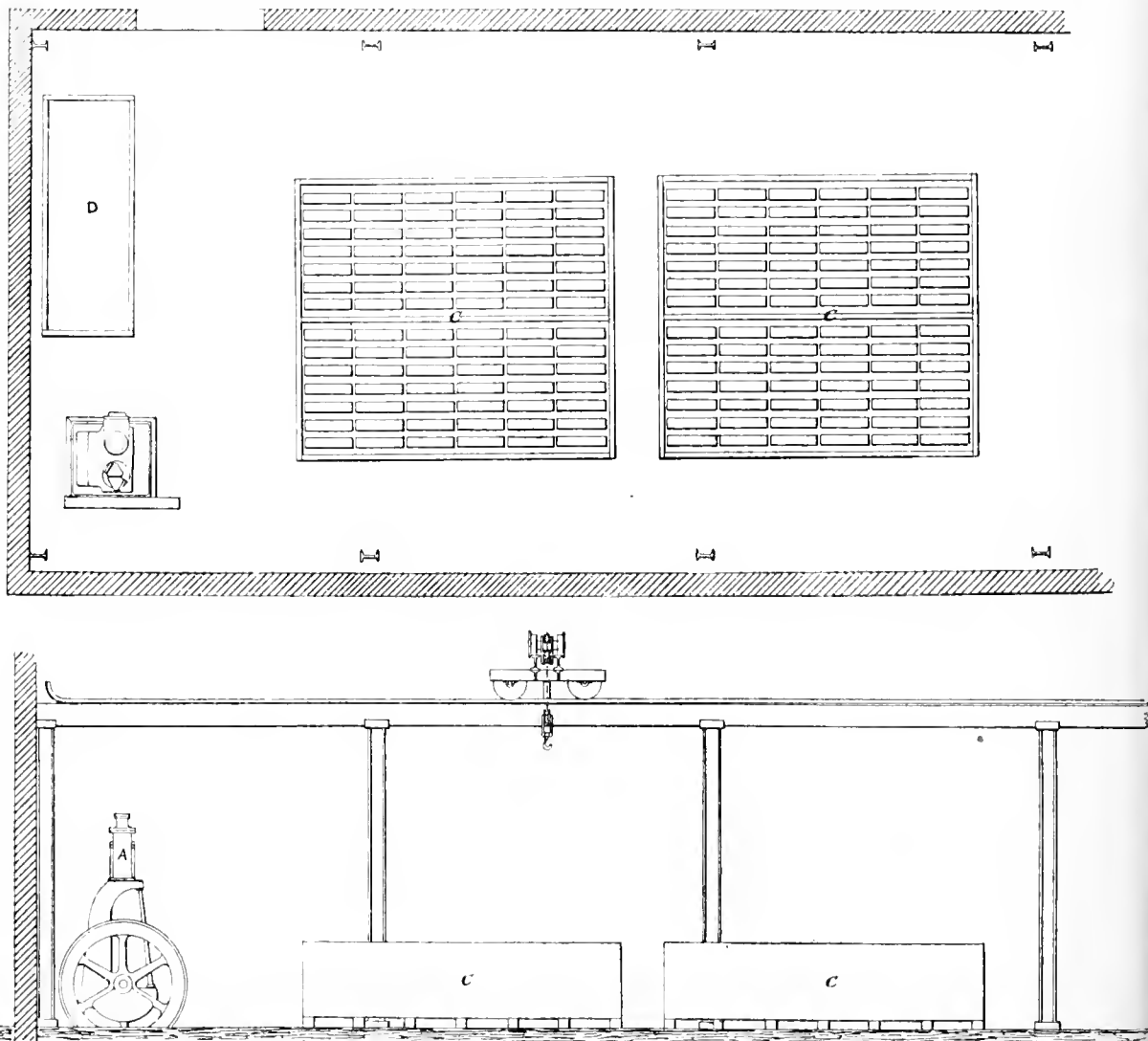
Assuming the apparatus to be in operation, strong ammonia liquor of about 7880 specific gravity will be drawn from the absorber by the pumps, and delivered through the economiser into the analyser at a temperature a little above the boiling point of water. The generator, which is an iron vessel heated internally by coils through which steam from the boiler is caused to circulate, is at this time full of very weak liquor, the vapour from which, at a temperature of some 260° F., passes into the analyser, where it meets the strong liquor from the absorber and heats it, driving off nearly all the ammonia in the form of vapour through the pipe at the top into the condenser, while the remaining liquor, which is nearly pure water, falls down the analyser into the generator. The ammonia vapour that passes off is necessarily mixed with some amount of steam, but this, on account of its high boiling point, compared with that of ammonia, is condensed immediately it enters the condenser, the watery particles being caught by suitable pockets in the rectifier, and run back to the analyser, while the almost anhydrous ammonia vapour passes on to the lower coils of the condenser, where it is cooled to the temperature of the cooling water, and assumes the liquid form. The refrigerator is a vessel containing coils of iron pipes, through which brine or any other liquid it is desired to cool is passed. It is in communication with the absorber, which is maintained at a low temperature by means of a circulation of water, and into which the weak liquor from the generator passes at a certain fixed rate. This cold weak liquor is ready to absorb ammonia, consequently if the anhydrous liquid be allowed to pass from the condenser to the refrigerator it will be immediately vapourised, and will pass over into the absorber and enter into solution with the weak liquor. The weak liquor being in this manner converted again into strong liquor, is now ready to be delivered back into the analyser; but as the pressure in this latter vessel, which is at a high temperature, greatly exceeds that in the absorber, which is cold, this has to be accomplished by means of pumps. In this way a constant flow is maintained, the liquor passing through the absorber drawing off the precise amount of ammonia from the refrigerator that is entering from the condenser, so preserving a constant pressure and temperature of evaporation. This is the complete cycle; but in order to prevent the loss of heat which would be caused by the weak liquor entering the absorber at a high temperature, it is passed through the vessel called the economiser, where it is brought into contact with the cold strong liquor on its way from the absorber to the analyser, the strong liquor receiving the heat which the weak liquor loses. Assuming the action of the economiser to be perfect, which of course is impossible in actual practice, it is obvious that all the heat given out by the condensation of steam in the generator coils would be found in the water issuing from the condenser, minus that portion directly lost by radiation and conduction from the vessels and pipes. The total heat expended is that required to vapourise the ammonia, and the water, which unavoidably passes off with it in the form

of steam, but which is condensed in the rectifier and returned to the analyser, plus the amount unavoidably lost.

The cost of producing clear block ice in this country with a Pontifex machine of 15 tons capacity per twenty-four hours may be taken at about 3s. 9d. per ton with good coals at 15s. per ton, exclusive of allowance for repairs and depreciation.

Another method of using ammonia as a refrigerating agent, which, though of modern origin, and only lately introduced into this country, has

& Co. A is the pump, worked by a small steam engine combined on the same frame, D the ammonia condenser, C the refrigerator, and ice tanks—of which only one set is shown. Assuming the apparatus to be charged with anhydrous ammonia, the action is as follows:—The connections being open, vapour would be passing from the refrigerator to the pump, where it would be compressed and delivered into the condenser, the liquefied ammonia passing from the bottom of the condenser back to the refrigerator. In the diagram the refrigerator is shown combined with



FIGS. 5 AND 6.—6½ INCHES.

already been largely adopted, is the compression system. In this apparatus anhydrous ammonia, which may now be obtained as a commercial article, is employed, the latent heat of vaporisation at atmospheric pressure being 900. The machine itself is of somewhat similar construction to that already described for ether, due allowance being made for differences of pressure and in the selection of material not acted upon by ammonia. Figs. 5 and 6 show plan and side elevation of a plant for producing ice on the ammonia compression system, as made by Messrs. Siebe, Gorman

the ice tanks, coils of pipes, within which the ammonia is vapourised, being placed between each row of ice cans, the intermediate spaces being filled with brine, made of calcium or magnesium chloride and water. In this way space is saved, and the heat is abstracted directly from the water to be frozen, so avoiding the losses which exist when an independent refrigerator is used.

Other things being equal, the working pressures in a compression machine are precisely similar to those in the absorption apparatus, depending, in the condenser, on the temperature of the cooling

water, and in the refrigerator, on the degree of cold to be produced. The power expended in working the machine is simply that necessary to raise the pressure and temperature of the vapour so as to cause it to liquefy at the temperature of the cooling water, and the heat carried off by the water is the heat of vapourisation liberated in liquefaction plus that acquired during compression. This latter quantity, notwithstanding that the liquefying pressure is so much greater, is less than with ether, on account of the less weight of ammonia required for a given refrigerating effect—the weights being in inverse ratio to the heats of vapourisation—that is to say, about $5\frac{1}{2}$ pounds of ether must be circulated to produce the same effect as 1 pound of ammonia. The cost of producing ice by the compression system may be taken at about the same as with the absorption apparatus. The first cost of the plant is less.

The last system which I shall deal with under this head, and that very shortly, is one in which liquefaction is brought about by a combination of mechanical compression and absorption, generally known as the binary absorption system. So far as I am aware, the earliest workers in this direction were Mort and Nicolle, of Sydney, who, in 1869, jointly patented an apparatus in which ammonia in solution with water was made to perform the part of a refrigerating agent. The apparatus consists of an evaporator or refrigerator, a pump, and an absorber. The evaporator is supplied with strong ammonia liquor, from which, by means of reduction of pressure produced by a pump, the ammonia is caused to evaporate, so abstracting heat from the liquid to be cooled. The weak liquor escapes at the bottom of the evaporator and finds its way back to the pump, where, meeting again with the ammonia vapour, they are together forced through suitable cooling vessels under sufficient pressure to cause the solution of the ammonia, the strong liquor thus formed being again passed into the evaporator. This machine, so far as I know, has only been used by the inventors. The great objection to it is that the whole of the water entering the evaporator has to be reduced in temperature, giving up its heat to the ammonia vapour, which to this extent is prevented from performing useful cooling work. In some degree, however, this is compensated by an economiser in which the strong liquor entering the evaporator is cooled by the weak liquor passing out.

In 1880, Messrs. Du Motay and Rossi produced a binary absorption machine in which they used a mixture of ordinary ether with sulphur dioxide, which they termed ethylo-sulphurous dioxide. Before deciding on the adoption of this fluid, they made numerous experiments with other combinations of ethers and alcohols, with acids, in order to take advantage of the low-liquefying pressure of some vapours, and the greater cooling power of others. They found that liquid ether possessed an absorbing power for sulphur dioxide amounting to some 300 times its volume at ordinary temperatures, while at 60° F. the tension of the vapour given off from the binary liquid was below that of the atmosphere. In working, it was found that both liquids evaporated in the refrigerator under the influence of the pump. In the condenser the pressure never exceeded ten or twelve pounds per square inch, this being sufficient to liquefy the ether, which then absorbed the sulphur dioxide. On this account a larger compressing pump is required with the binary liquid than with pure sulphur dioxide, but the steam power to drive it is less, owing to the much lower pressure necessary to produce liquefaction. I have no particulars as to the cost of making ice by this

process, but presume it must be somewhat less than that when sulphur dioxide alone is used.

The last apparatus of this kind is one which was brought out by Pictet in 1884. So far as the apparatus itself is concerned, it presents no novelty of any importance. The peculiarity lies in the liquid, which is termed "Pictet's liquid," and which consists of carbon dioxide and sulphur dioxide, formula CO_2S . The curve of vapour tensions for this liquid is shown on Fig. 1, and it is exceedingly remarkable that for temperatures above 78° F. the tensions are actually less than for pure sulphur dioxide.

CLASS II.—HEAT ABSTRACTED BY EXPANSION OF GASES WHEN PERFORMING WORK.

This subject has been dealt with by Mr. J. J. Coleman before the Glasgow Section, in a paper on "Different Methods of Producing Cold Artificially," read on the 13th of May, 1884. My remarks under this head will therefore, to a large extent, be supplementary to Mr. Coleman's paper.

The dynamical theory of gases, though now well understood by those who have given attention to the subject, is of comparatively recent origin, its full development being due to Professor Clausius. When a gas is compressed by a piston, it becomes heated, owing to the conversion of mechanical energy expended in moving the piston into thermal energy. The heat thus acquired, supposing compression to take place in a heat-proof cylinder with frictionless piston, is the precise thermal equivalent of the work expended during compression, according to the law formulated by Dr. Joule in 1845. During expansion in a heat-proof cylinder with frictionless piston the reverse action takes place, the gas losing heat in performing work, the heat thus lost being the thermal equivalent of the mechanical work performed. Compression and expansion may, however, take place without either rise or fall of temperature, provided that the heat due to the mechanical work performed is in the one case abstracted by some external body, and in the other case is supplied from some external source. This is called isothermal compression and expansion, and the laws relating to it may be expressed by saying that—

$$\frac{\text{Volume} \times \text{absolute pressure}}{\text{Absolute temperature}} = \text{Constant for each particular gas.}$$

The other method of compression and expansion is called adiabatic, and for it the following are the relations between temperature, volume and pressure, of any two points in the same curve—

$$\frac{t}{t'} = \left(\frac{v'}{v}\right)^{\gamma-1} = \left(\frac{p}{p'}\right)^{\frac{\gamma}{\gamma-1}}$$

t , v , and p being absolute temperature, volume, and absolute pressure before expansion, or after compression; t' , v' , p' , those after expansion or before compression; and γ the ratio of the specific heat under constant pressure to that with constant volume.

Neither compression nor expansion do in practice take place either adiabatically or isothermally, the actual curves lying somewhere between the two, approaching the former in quick speed unjacketted or badly jacketted compressors, and in well-protected expansion cylinders; while with slow piston speeds with internal water injection during compression, and in thin unclothed expansion cylinders, the curves may approximate very closely to the isothermal. It is obvious therefore that in order to cool air, all that is necessary is to provide a supply in a compressed form at such temperature and pressure as will give the desired reduction after expansion in the performance of work, bearing in mind that in

practice the degree of expansion is generally limited at one end by the pressure of the atmosphere, while the initial temperature before expansion is also fixed by the temperature of the water available for cooling.

Atmospheric air is, however, never dry, but always contains aqueous vapour in solution, the amount varying under climatic influences, from that required to produce saturation, to about one-fifth of that

direct proportion. With saturated air, therefore, either reduction in temperature or increase in pressure, or both combined, will cause liquefaction of a portion of the contained vapour, while, if the air be not fully saturated at first, its relative humidity is increased, until, finally, the dew point is reached, after which liquefaction would commence.

In practice, with such apparatus as I am at present dealing with, there is always liquefaction of vapour

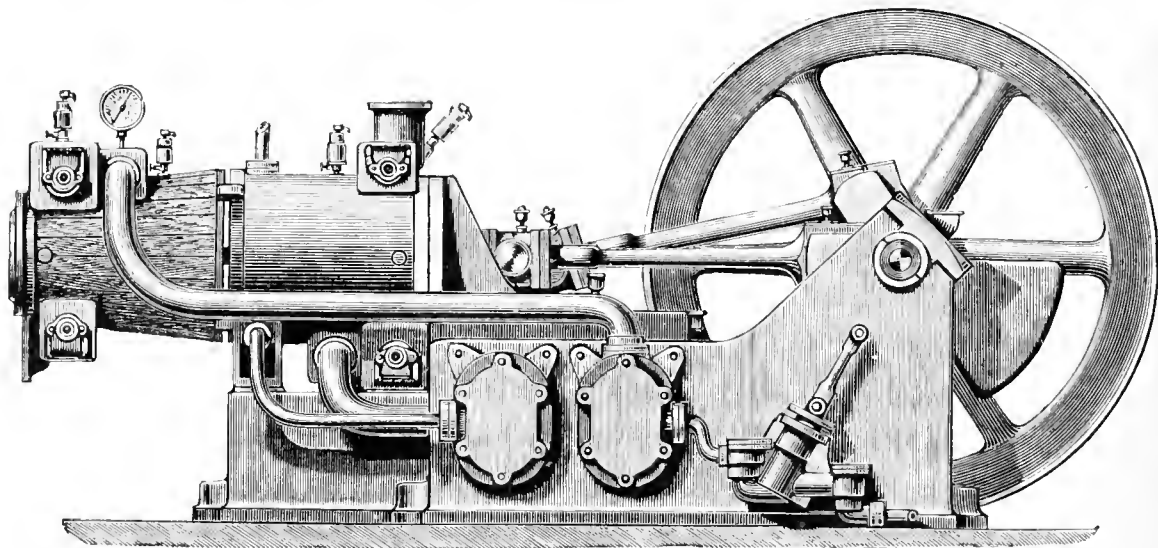


FIG. 7.

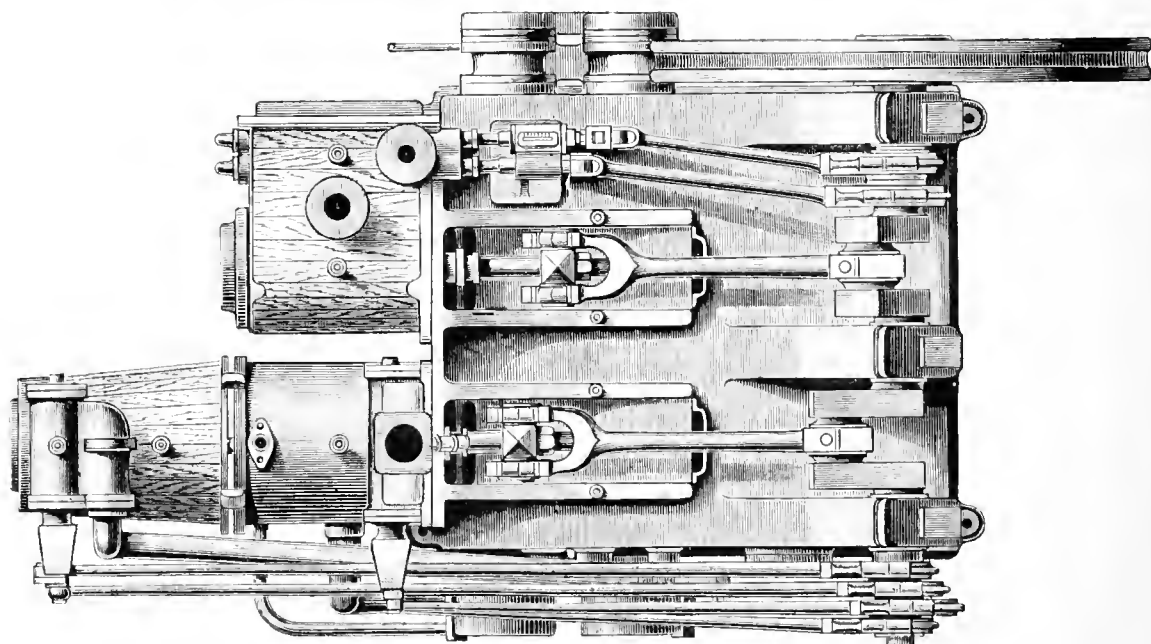


FIG. 8.

quantity. The temperature of saturation or "dew point" varies according to the quantity of vapour in solution, the smaller the amount, the lower being the dew point.

The capacity of air for holding moisture is also affected by pressure, a diminution in volume under constant temperature reducing this capacity in

by the combined action of the pressure and cooling after compression, while during expansion the intense cold not only causes a further condensation, but immediately converts the water so produced into ice. It is necessary, therefore, to take these effects into consideration in designing air-cooling machines. A complete apparatus of the horizontal type is shown

by Figs. 7 and 8, and a vertical belt-driven machine by Fig. 9. Air enters the compressor, and passes by a pipe to the coolers, which are placed in the bed-plate, and consist of a couple of iron vessels containing Muntz metal tubes, through which water is circulated by a pump, passing in by a pipe through the tubes, and away to the compressor jacket, from whence it escapes. The vapour condensed from the air in the coolers, collects at the bottom, and is run off from time to time. In its passage through the coolers, the temperature of the air is brought down to within about 5° of that of the cooling water. The quantity of water required is about 20 gallons per 100lb. of air, but where it is of importance this amount may be reduced by altering the construction of the coolers. The cooled and dried compressed air passes by a pipe to the expansion cylinder, where it performs work on the piston, returning from 50 to 60 per cent. of the power expended in compression, and

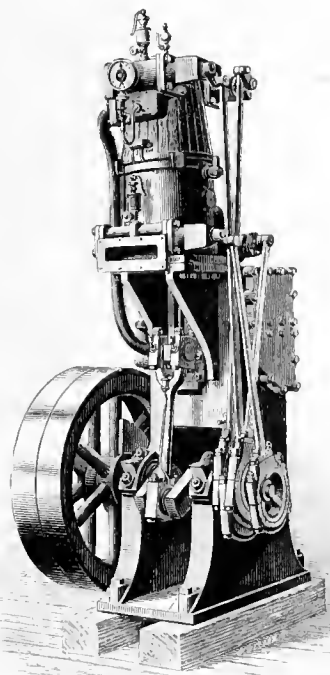


FIG. 9.

is exhausted, cooled to from 30° to 100° below zero F., according to the size of the machine, the speed, the degree of compression, and the initial temperature of the cooling water. The difference between the power used in compression and that given off in expansion, plus the friction of the machine, must be supplied from some external source. In the diagram, a steam cylinder is shown for this purpose, and this may of course be condensing or compound, the design readily allowing either of these types to be employed. Small machines are frequently driven by a belt, as shown in Fig. 9, either from a gas-engine or some existing source of power.

In some refrigerators, the compressors, instead of being jacketted, are supplied with an internal injection of cold water. This plan, however, while it secures a lower temperature during compression, is, in my opinion, objectionable, as in many cases pure water cannot be obtained for cooling purposes, and, therefore, the air becomes contaminated. Besides

this, when nearly dry air is being used in the machine, as is generally the case when the air is drawn back into the compressor from the room or chamber in which it has been utilised, fresh moisture is taken up, and this causes a loss in effect, due to the liberation of the heat of vapourisation and liquefaction during condensation and conversion into ice. With injection also it is essential to use some sort of supplementary cooling apparatus, such as the inter-changer described in Mr. Coleman's paper, otherwise the large quantities of snow formed during expansion would be likely to occasion great trouble.

With regard to the power required in cooling air, it may be said that about seventy-five indicated horse-power will produce 40,000 cubic feet of air per hour cooled to 80° or 90° below zero Fahrenheit, under ordinary working conditions. Measured merely by abstraction of heat, this result is of course far inferior to that obtained with any of the apparatus described in the previous section. Air machines are, however, employed under conditions which render the use of other apparatus impracticable—such, for instance, as on board ship, and on land for the freezing and preservation of meat, for cooling chocolate, butterine, gelatine dry plates for photographic purposes, and in many other instances where the advantage of having a simple and compact apparatus, capable of producing dry air at a very low temperature, is found to counterbalance the extra expenditure on account of fuel.

CLASS III.—HEAT ABSORBED IN THE RAPID MELTING OF A SOLID.

The reduction of temperature which accompanies the melting of a solid, is due to the absorption of heat in changing the molecular state, and to the rapidity with which such change is effected. Freezing mixtures all depend for their action on this rapid change of state; a simple mixture of three parts of snow and four of potash causing a reduction of temperature from freezing point to 51° below zero Fahrenheit. Such a mixture is, however, inapplicable for commercial purposes, except on a small scale, and the same may be said of all those in which snow or ice is employed. Considerable depression in temperature may, however, be caused without the use of ice by dissolving certain salts in water or acid, and from time to time attempts have been made to produce ice on a practical scale by such means. Many years ago the late Sir W. Siemens made use of calcium chloride in connection with his principle of heat regeneration, which in this case was applied in a negative manner for the abstraction and rejection of heat. When crystals of calcium chloride are dissolved in water, the temperature is lowered about 30° F. With water at 60° to 65° initial temperature, this reduction is not sufficient to produce ice, and Sir William Siemens therefore devised an apparatus in which the cold could be accumulated or intensified by making use of the low temperature of the spent liquor in abstracting heat from the water to be cooled. The liquor was afterwards evaporated, and the salt recovered. I believe this apparatus worked well and produced ice, but it was abandoned by the inventor, who considered it inferior to mechanical methods employing a volatile liquid.

In the Toselli machine, which has been sold in considerable numbers, ammonium nitrate is used. This salt, when dissolved in water, reduces the temperature some 40° F. The apparatus consists of a vessel in which the solution is effected, and a multiple ice can, containing slightly tapered cylindrical moulds of various sizes. When the freezing mixture is complete, the ice can is introduced, the moulds having previously been filled with water. In a few

minutes ice is formed round the edges, to the thickness of about one-eighth of an inch. These rings are then removed, and placed one within the other, so forming a small stick of ice. The Toselli machine can only be used when a supply of water below 60° F. can be obtained.

Recently in the United States an attempt has been made to employ ammonium nitrate for the production of ice on a large scale, in a modified form of Sir William Siemens's apparatus, so as to enable a freezing temperature to be produced independently of the initial temperature of the water supply. Several forms are proposed. One of them is called a quadruplex ring machine, and is made to freeze from two to fifty pounds of ice per hour. It consists of a series of annular vessels, one within the other, containing in the centre the moulds in which ice is to be formed. The cold produced by dissolving the salt in the outer ring cools water in the second one. This again, on salt being added, cools the third, and the third the fourth, the temperature in this way being reduced sufficiently to freeze the water in the moulds. Two, three, or more rings are used according to the initial temperature of the water. No motive power is required beyond that necessary to keep the whole apparatus in motion, so as to promote the solution of the salt. I am not aware whether the system has actually been applied on a large scale, but apparatus has been designed for such an application. In this case the process would be continuous, ammonium nitrate being automatically fed into a tank, where it would be dissolved in water previously cooled by the spent liquor after it had left the ice-making tanks or cooling rooms. The fresh liquor at a low temperature would be circulated by suitable pumps, and returning through the heat-exchanging apparatus just referred to, would finally pass into an evaporating tank, where by means of heat the water would be driven off and the ammonium nitrate recovered.

No doubt such a plant could be made to work satisfactorily, but it is certain that unless most of the evaporation could be performed in the open air, without the use of fuel, it would be most expensive to work, as the amount of fuel to evaporate the whole of the water would be far greater than that required to produce the equivalent cooling effect with any of the apparatus employing a volatile liquid as the refrigerating agent.

CONCLUSION.

In concluding this somewhat lengthy paper, I must observe that it must be understood that the machines and apparatus which have been specially referred to are not the only ones of the kind. They are merely given as examples to illustrate the different systems, and have been selected by me because they are those with which I am most familiar, and because they are, in my opinion, good examples of their respective classes. The paper does not deal with mechanical details, and it is only in these that the machines of various makers differ with one another.

For assistance in the preparation of diagrams I must acknowledge my indebtedness to Messrs. Siebe, Gorman & Co., and Messrs. Pontifex & Wood.

DISCUSSION.

The CHAIRMAN said that Mr. Lightfoot's paper was peculiarly valuable, inasmuch as it was the first which had dealt with the whole subject, and being directly associated with this kind of work, his statements commanded full confidence. Probably few of the members had any idea to what extent refrigerating machinery was now used. Mr. Lightfoot's reference to Pictet's liquid was one of the most interesting

features of his paper from a scientific point of view. It showed the great importance of further investigation into the mutual relations of various volatile fluids. The discovery that a mixture of carbon dioxide and sulphur dioxide had a vapour pressure considerably below that of the less volatile was certainly a very remarkable one. It was usual to regard sulphur dioxide as simply SO₂ and carbon dioxide as CO₂, whereas Pictet's work showed distinctly that, at a considerable distance above their boiling points, and indeed above ordinary zero, the molecules of these gases must be of more complex composition.

Mr. HARRISON said that he brought out the ether machine in 1856, his attention being first drawn to the subject by the arrival in Sydney, in the year 1837, of a cargo of ice from America. Having studied chemistry under Professor Graham at the Andersonian Institute in Glasgow, he thought that it might be possible to make ice. He accordingly took two ordinary thermometers and surrounded the bulb of one with ammonia and the other with ether. The one with ammonia fell very rapidly, but the effect of the ether was more prolonged; so after working out an ammonia process something on Carré's principle, he discarded it in favour of ether, and took out his first patent in Australia. He then came to London and employed Mr. Siebe to make his first two machines, a small one and a large one. After spending £2000, and realising that the time was not ripe for ice machines in this country, he took the big machine back to Australia, and in two years drove the Americans out of the field. At that time he knew nothing of previous failures, and was not even aware of Perkins' machine until some years after he had ceased to take any part in the business. The only practical point on which he could give any information was with regard to Table I. The figures there were perfectly correct at the temperatures given, but they were to some extent delusive. The latent heat of water when evaporated at the freezing point in a vacuum was about 1100° instead of 900°; sulphuric ether when evaporated at about 20° had a latent heat of considerably more than 165°, which was the right figure at the temperature of 96°. The latent heat of ammonia, on the other hand, at the usual working temperature, was considerably less than 900°. This was rather important practically, though he could find no record of it. For practical purposes white ice was superior to clear ice, in the same way as white sugar was preferable to sugar-candy for sweetening, because it melted more quickly, and produced a more rapid effect. He had in Australia to combat the prejudice in favour of clear ice, but ultimately the white ice was preferred.

Mr. GORMAN remarked that the author of the paper had very modestly refrained from saying, with regard to the cold-air machine in the diagram, that it was his own invention. It was doing good service, and was in use for freezing meat, and more lately fish, in many parts of the world, simplicity of construction being one of its chief advantages, as there were no valves to get out of order. They were still making the ether machine, on account of its simplicity of action: it had few joints to keep sound, and worked at a low pressure, never amounting in this climate to more than 4lb. per square inch in the condenser, and in India to 11lb. when the thermometer was at 92°.

Mr. CHRISTY exhibited a sample of Japanese isinglass made from seaweed by a freezing process. Being too fine to be strained, it was frozen solid by a current of air passed through a freezing mixture, and cut into the requisite sizes. On thawing the water drained away with the impurities, leaving the mass perfectly dry and solid.

Dr. MESSEL thought that Pictet's liquid deserved more attention than it had received. The author's cold-air machine, like all mechanical refrigerators, converted only the amount of heat into mechanical energy which was added to it by the fuel used, but in Pictet's machine, using his new liquid, there was molecular work done in addition; and therefore, if Pictet's statements were correct, it ought to be the cheapest of all ice machines at present known. Of course it was possible that other liquids might have similar properties, but this was the only one known at present. Pictet's explanation was that it required less horse-power to liquefy the mixed gases than the gases separate; whilst, when gasified again, they would give up latent heat equal to that of the two gases taken independently.

Mr. LIGHTFOOT said, in reply, that he did not quite appreciate the force of Dr. Messel's remarks. Putting aside friction in all compression machines, no matter whether a gas or condensable vapour was used, the whole of the heat utilised from the fuel was converted into mechanical energy. In Pictet's new machine, as in other previous ones employing a binary liquid, no doubt the mechanical work necessary to cause liquefaction was less than if either of the two liquids was used alone, but it did not follow, as Dr. Messel had said, that "it ought to be the cheapest of all ice machines at present known." It might be so, but, from a circular he had seen, it appeared that, notwithstanding the advantage gained with the binary liquid, Pictet used about double the horse-power that was required with anhydrous ammonia. Dr. Messel was also mistaken in saying that Pictet's was the only binary liquid at present known, as at least one other had been in use for several years before Pictet's was brought out. With regard to Perkins' machine, it was only right he should say that he believed it was simply an experiment, only worked in the factory where it was constructed. There was no doubt very few people knew of its existence, and Mr. Harrison's invention, some years later, was quite independent and original. With regard to Mr. Harrison's criticisms upon the table of heats of vaporisation, he had already stated that the figures he had given were at atmospheric pressure, and would have to be modified according to the temperature. He was not aware that other determinations had been made, and should be glad if Mr. Harrison could tell him where they were to be found.

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Vice-Chairman: I. Levinstein.

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Watson Smith,
L. Siebold,
Wm. Thomson,
D. Watson.

Local Secretary:

J. Carter-Bell, Bankfield, The Cliff, Higher Broughton, Manchester.

MEETINGS, SESSION 1885-86.—First Tuesday in each Month, at 7 P.M.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

ERRATUM.—In the paper of Mr. Rowland Williams, appearing in the last (February) number of this Journal, page 73 and sixteen lines from bottom, after the word "and" should be inserted the words, "after decomposing with a slight excess of acid."

ON A METHOD FOR THE DETERMINATION OF THE RELATIVE STIFFNESS OF PASTE PRODUCED BY ACTING ON FLOUR OR STARCH WITH BOILING WATER

BY WILLIAM THOMSON.

Flours or starches, like others of the carbohydrates, whilst possessing similar chemical percentage composition, differ very materially from each other in their physical properties; thus, cane and beet-root sugars have precisely similar percentage chemical compositions, yet the former is much sweeter to the taste than the latter; and so with flours or starches—whilst two samples may possess the same percentage composition, the one on being mixed with boiling water might give a much thicker paste than the other, the same weights of each being employed. Calico printers and sizers take cognisance of this difference between samples of flour or starch, some preferring for their purpose those which give the thickest paste, whilst others select those for their manufacture which produce the thinnest. Upon this quality of the starch or flour much depends, and disputes often arise between buyer and seller as to the qualities of such materials in this respect. In calico printing for instance, the colour is mixed with starch paste to give it consistency, and it is evident that the starch which gives the necessary consistency with the smallest quantity of dry starch will be the most valuable for that purpose; again, in sizing yarn where it is desired to introduce the smallest possible quantity of size into the warp, the starch or flour which gives the thickest paste on being boiled with water is selected.

The method which is at present employed for testing flours and starches is to take a certain weight of the sample, place it in an ordinary sauce-pan or basin, add a measured quantity of water, and heat till the water boils; after boiling for one, two or three minutes, the paste is poured into an ordinary glass or cup and allowed to cool. The pastes are then removed from the cups by tilting them upside down, when the paste having the shape of the vessel in which it cooled is left. The relative stiffness of these pastes are then roughly judged by pressing the fingers into each, and noticing as far as possible which offers greatest resistance to the pressure of the finger. This method is unsatisfactory from several points of view: first because it is possible that the same sample of flour may be boiled at two different times by the same person, and by reason of the one having being boiled or heated before boiling for a longer time than the other, a greater amount of water may evaporate from the one than from the other, thus making considerable difference in the consistency or stiffness of the pastes each would produce. I have overcome this difficulty by making the paste in a closed vessel. At first I used ordinary stoppered bottles in which equal weights of the different samples to be tested were placed along with equal quantities of water; the bottles with their contents were then put into a tin vessel containing cold water, which was gradually heated to boiling, the bottles meanwhile being shaken from time to time. This appeared to give a satisfactory paste, which was then poured out and further examined on becoming cold. I found, however, that the paste so produced was not satisfactory, because as soon as it became thick it was impossible to mix it further by shaking the bottles, and it was difficult to pour out the paste so as to obtain an absolutely homogeneous mixture, as I found on testing the pastes afterwards by the process hereinafter mentioned. After a number of further experiments I arrived at

the following method for making the pastes. 1 part of flour, for instance, is mixed with 6 parts of cold water in a glass cylinder 12 inches long by 2 inches diameter, the mouth being firmly closed with an india-rubber cork through which passes a wire about $\frac{1}{4}$ inch diameter, terminating in a round disc formed by first bending the wire at right angles to itself, and then coiling it round itself until a circle of sufficient diameter has been formed. This disc of coiled wire acts as a plunger, being drawn up and pushed downwards by the straight piece of wire which passed airtight through the india-rubber stopper, the hole in the stopper being lubricated with castor oil. The glass cylinder has a flanged top which enables the stopper to be firmly tied down. A number of these cylinders, charged with equal weights of flour or starch, and mixed with equal volumes of water, are placed in a large vessel containing cold water sufficiently deep to nearly cover the upright cylinders. The water in this vessel is then gradually heated to boiling, the plunger being worked in each cylinder alternately during the time of heating to keep the flour and water well mixed. About five minutes after the water has reached the boiling-point the plungers are drawn to the surface, which is levelled by twisting the plunger round on the surface, and then drawing it up still further till it touches the rubber cork. The pastes are then allowed to cool and afterwards tested. The first and I believe only attempts which have been made to quantitatively determine the relative stiffness of different pastes was to place weights on the surface, and observe what weight was required to break through the surface or skin. There are two serious objections to this method: the first is, that a little more drying of the surface of one paste than another would make the one support a much heavier weight than the other, although both pastes might have been made in the same way from the same sample of flour; again, there is a surface tension on the paste, as there is on water, so that if the weight be carefully manipulated, the paste may be made to support a much heavier one than it would do if less care were used, much on the same principle as a dry sewing needle may be made to float on water if carefully placed on its surface. Further, it is somewhat difficult to get a weight having its centre of gravity in a vertical line passing through the centre of the weight, and consequently one part of the edge of the weight is likely to press on the paste more than another, the result being that the weight gradually tilts over to one side, and the edge being generally sharp cuts through the surface and the weight then embeds itself edge foremost. That this method has never proved successful in the hands of anyone, is shown by the fact that, although a quantitative method would be most valuable, no quantitative results expressing the stiffness of flour or starch pastes have ever been employed by either buyer or seller.

One method at which I worked and which at first seemed promising, was to measure the pressure of air required to force the paste through a hole of given dimensions. For this I poured different pastes in the different tests into an ordinary glass funnel, the stem of which passed airtight through a cork, and was closed by a cap of india-rubber. When the paste has cooled and set, the cap is removed from the stem of the funnel, the cork fitted into a flask, which is connected with a vacuum pump and manometer by a tube which also penetrated the cork, the pressure required to force the paste through the stem of the funnel into the flask is then read off, and although it is possible that satisfactory results may yet be obtained by some modification of this method, I had to abandon

it as unsatisfactory, the pressure required at one time to force the same paste through the stem being much greater than that required at another, for some reason or reasons which I was unable thoroughly to comprehend.

The last process I devised has given satisfactory results, and will be still further improved. It is based on the principle of allowing some body having a known momentum to enter the paste, and then to express in measurement the distance to which it penetrated the paste before coming to rest. Perhaps the most scientific method of using this principle would be to make use of an air gun, or some other appliance, to propel a bullet with precisely the same velocity into columns of paste lying horizontally, but I thought it highly improbable that a bullet of constant weight could be obtained which could be shot always at a constant velocity; besides, assuming that such conditions could be fulfilled, a still more difficult problem would be to find the bullet after it had entered the paste.

The method which I ultimately employed as the most practicable which occurred to me, was to allow a rod or spindle of iron, $\frac{1}{4}$ in. diameter and 10 in. long, sharpened pencil-like at both ends, to acquire a standard momentum by falling through a space of 12 inches, and to measure the distance to which it penetrated the paste, on falling.

The iron rod was suspended from one end by being made to adhere to one of the poles of an electro-magnet, and when the rod was hanging at rest, the magnetism was destroyed by breaking the current (produced from a small bichrome cell) by means of a switch. The moment the current is broken the spindle drops, and remains at rest embedded to a greater or less depth in the paste. The finger nail can be used as a mark of the part of the spindle which is at the surface of the paste, when it can be withdrawn and immediately measured on an ordinary rule.

If the paste be too thin, the rod may descend through it to a considerable distance before coming to rest, and the *vis viva* having been destroyed, the spindle may then sink slowly by the continued action of gravitation. It is possible under those circumstances to catch the spindle between the fingers the moment the energy produced by the fall has been expended, but when the paste is so thin as this, the results cannot be considered satisfactory. I tried some experiments by using rods of three-quarters, and of half the length of the original rod or spindle, and tried to calculate the results yielded by the one into that which would be given by the other, by use of the ordinary formula of mass and velocity of the falling body, but I found no satisfactory result could be obtained from it. The lighter the spindle the less penetrating power it had for the 12 in. fall, but it cannot be said that a paste which is penetrated by a spindle to the extent of 1 in. has twice the stiffness of another paste which the same spindle penetrates to the extent of 2 in. Doubtless the best way of making use of this process to obtain accurate results is to take a standard flour or starch, and to make it into paste simultaneously with the samples to be tested against it; and after preliminary trials of all, to increase or diminish the quantities of the samples till they are exactly equal to the standard as tested by the penetration produced by the fall of the spindle.

In making the experiment with the spindle, I take the glass jars in which the pastes were prepared, and after leaving them over-night in cold water, that the whole paste may come to the same temperature, I place each jar alternately under the electro-magnet, then take a thread to which is attached a small lead

weight. This is suspended from the centre of the pole of the magnet to which the spindle is afterwards suspended, and the jar arranged underneath that the first fall will take place about the centre of the paste; other falls can be made on to points surrounding the centre. I find it practicable to make in all about 8 tests on each paste, the mean of which I think gives a fairly satisfactory result. In my first experiments I did not place the pastes in cold water over-night, and I found the distance penetrated by the fall of the spindle into the centre was less than when it fell near the sides of the vessel; but the cause of this I found to be mainly due to a difference in the temperature, the paste in the centre being several degrees colder than that at the sides. The temperature therefore at which these experiments are made should always be accurately noted immediately after the tests have been made.

As ordinary jelly (solution of glue) is presumably more easily obtained perfectly homogeneous than flour or starch paste, because it is quite liquid when hot, I made most of my preliminary experiments in that medium, and the following results will show: *First*, that the different tests made with jellies or pastes agree reasonably closely with each other; and *Second*, that the temperature affects very materially the stiffness of either.

In determining the distance to which the spindle penetrated the jelly or paste, I took as a unit the sixteenth of an inch, so that the following numbers must be read as sixteenths of an inch as measured on the spindle—thus if the spindle penetrated 1 in., the number given would be 16; if 2 in., 32, and so on.

The same jelly was employed for each of the following experiments. When one series of experiments was made, the jelly was melted in the well-closed glass cylinders to prevent evaporation, and then cooled for the next experiment. The jelly was made by dissolving 1½ ounces of gelatine in 20 ounces of water.

Temperature of Jelly, Centigrade.	Mean of Results Obtained.	Actual Result Obtained.
9.5	43.8	43, 43, 45, 41, 41.
11.6	45.5	44, 45, 47, 46, 46, 45.
12.0	46.3	46, 47, 46.
12.1	46.2	46, 45, 48, 46, 46.
12.5	43.4	47, 49, 49, 47, 50.
14.4	63.5	68, 60, 64, 62, 65, 62, 63, 65.

The following are three samples of air-dried India corn starches. The pastes were prepared by heating at the same time 1 part of each sample with 10 parts of water. The samples Nos. 2 and 3 are by the same maker, and No. 1 by a different maker.

No.	Temperature, Centigrade.	Mean of Results Obtained.	Actual Results Obtained.
1	15.8	41.7	40, 44, 41.
2	15.8	57.4	52, 56, 60, 61, 58.
3	16.2	51.3	52, 54, 59, 55, 54.

These results will serve to show generally what the process can do; that at all events it gives reasonably concordant results for the same samples, considering the nature of the material with which we have to deal; and they are given with the hope that others

will expend some time and ingenuity in devising a still more accurate method of measuring the stiffness of different samples of flour or starch pastes—a matter which is of so much importance to calico printers, and to sizers and cotton manufacturers. I have to thank my assistant, Mr. W. H. Dawson, for the care and work he has expended over these experiments.

DISCUSSION.

Mr. GRIMSHAW thought that the author had made a distinct advance on the old rule of thumb method, although one might doubt whether buyers and sellers would adopt a plan which involved the use of an electro magnet. The results would, however, gain in accuracy if stronger pastes were used.

Mr. ESTCOURT said that an admitted defect of the process was that the depth to which the spindle penetrated was no arithmetical measure of comparison between two starch samples without going into a very abstruse calculation. If, after a preliminary test or two, Mr. Thomson were to dilute the stiffer sample until the spindle entered both to the same depth, then the quantity of starch used to make each paste would be an inversely proportional measure of their relative resistances.

Mr. THOMSON, in reply to a question put by the Chairman, said that he did not think that the stiffness produced in cloth would be proportional to the stiffness of the paste. It was very questionable whether it would not be in inverse ratio. It was generally considered that the stiffer the paste was, the more valuable it was to calico printers and others. Complaints were constantly arising in reference to farina sent from Hamburg not being up to sample, and hence it was important that some accurate method of testing should be devised. His process was capable of distinguishing, within two or three per cent., the difference between two starch pastes; but, as Mr. Estcourt had pointed out, when very accurate results were required, the sample to be tested must be assimilated to the standard paste employed by making repeated trials, and adding more or less water on each occasion. The test was as yet only a relative one, but he had brought it under the notice of the meeting in order that it might engage the attention of investigators, who would work it up into a scientific method. It was quite possible that by heating starch pastes until they boiled, stiffer pastes could be obtained than by merely heating them with hot water. For mixing with colours they were only heated to the point at which the granules burst, in which case the suggested test would be quite accurate enough; but there was no reason why the pastes should not be heated to any desired temperature. Among the experiments which he had made, was one in which the paste was poured into long test-tubes before testing. The results were not, however, concordant, owing to air becoming entangled in the starch as it fell into the tube, and unduly facilitating the fall of the spindle.

COMPARATIVE GASOMETRIC ASSAYING, WITH ESPECIAL REFERENCE TO THE VALUATION OF ZINC POWDER, AND THE TESTING OF CARBONATES.

BY J. BARNES.

SOME time ago I devised a method for the valuation of zinc powder,* the value being deduced from the

* Journal of the Chemical Society, xxxix. 463.

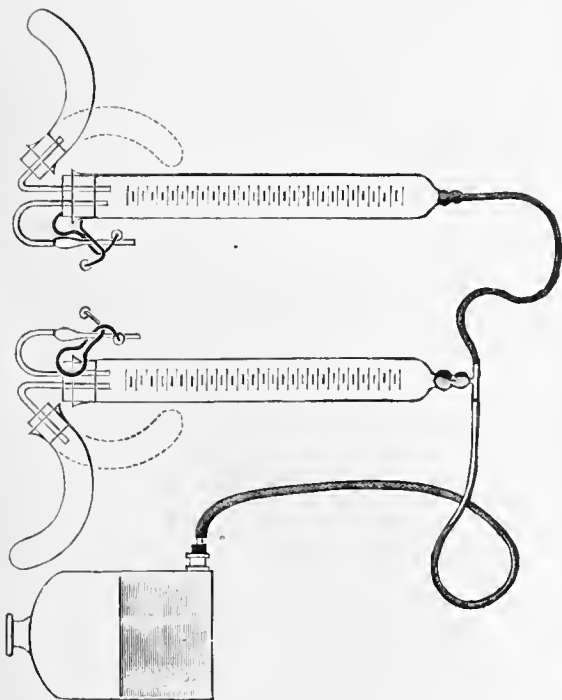
by momentary boilings at short intervals until the paper had become pulpy. Each test tube was then submitted to two or three minutes' cooling by immersing it in a beaker of water, and the outside then dried by lightly brushing it over with the edges of several folds of filter paper. After the lapse of about a quarter of an hour, the water in each of the burettes and in the aspirator was brought to the same level, and the readings taken—

Vol. of H from zinc foil = 71.5cc.
 " " " powder = 65.7 "

Considering the zinc foil to be pure Zn, which for commercial purposes may be done, R becomes 1; *w* of course is equal to W, and the calculation is simply—

$$\frac{65.7 \times 100}{71.5} = 91.9 \text{ per cent.}$$

When the tubes are charged with a saturated solution of common salt, acidulated with HCl, the apparatus may be used for the determination of CO₂.



About .25gram. of pure Na₂CO₃ was placed between watch glasses and counterpoised. The sodium carbonate was then brushed off on to a piece of thin paper and folded up. Equilibrium was then restored by calc spar, and the latter likewise folded in thin paper. Both were then placed in the apparatus and treated like the zinc in the previous experiment:—

Vol. from CaCO₃ (standard) = 59.8cc.
 " Na₂CO₃ " = 56.5 "

In this case R = .44, and the following calculation gives the percentage of CO₂ in the Na₂CO₃—

$$\frac{56.5 \times 44}{59.8} = 41.57 \text{ instead of } 41.51 \text{ (the amount theoretically contained.)}$$

The method gives good results, even when the volumes of gas differ considerably more than in the case just given, as for instance:—

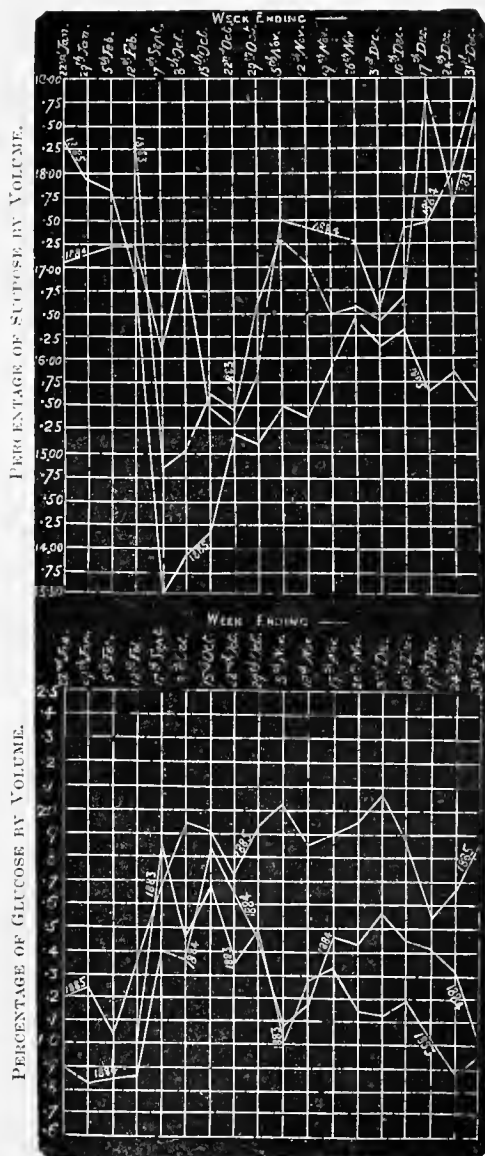
.2492gram. calc spar gave 59.6cc.
 .1520 " " " 36.25cc.
 1520 = .6099 3625 = .6082
 2492 = .6099 5960 = .6082

When a large number of samples of the same kind have to be tested, it would obviously be advantageous to have a series of burettes all connected with one reservoir of liquid—one of the burettes serving to collect the gas from the standard, and each of the other burettes to collect the gas from equal weights of the samples. Finally I may draw attention to the fact that in the case of carbonic acid determinations we have in the three carbonates of Ca, Sr, and Ba, a convenient series of standards containing varying percentages of CO₂.



DIAGRAMS SHOWING THE AVERAGE PERCENTAGES OF SUCROSE AND GLUCOSE BY VOLUME RESPECTIVELY, IN THE JUICE FROM THE CANES GROWN ON PLANTATION TUSCHEN DE VRIENDEN, DEMERARA; FOR EIGHTEEN CORRESPONDING WEEKS IN THE LAST THREE YEARS.

BY J. OWEN ALEXANDER,
 Chemical Laboratory, Demerara.



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Notices of papers and communications for the meetings to be sent to the Local Secretary.

ERRATA.—On page 81, vol. v. (February, issue), 2nd column, 4th line from bottom, for "Humphrey" read "Humaphry." On page 85, 1st column, 29th line from bottom of text, the quotation should end after "etc." On same column, 6 lines lower, for "manufacturer" read "manufacture." On page 86, 1st column, 20th line from top, for "chloride," read "chlorides." In same column, 4 lines lower, "in" at end of line should read "on;" and in 12th line from bottom, "Zinc" should read "Tin." On 2nd column, last line of table, for "10" read "100." In the broad table on same page, 4th column, last line but one, for "0.42" read "0.42." In page 88, 2nd column, 16th line, for "CARRIAGE" read "COINAGE." On page 89, 1st column, 29th line, for "could" read "would;" and on same column, 24th line from bottom, for "alloy" read "copper-alloys." On 2nd column, 3rd line, for "round" read "sound;" in 19th line there should be no comma after "Allen;" and in 23rd line from bottom, for "contest" read "control."

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University of Glasgow.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

The Fifth Meeting of the Session was held in the Rooms, 207, Bath Street, on Tuesday, 2nd March, 1886.

PROFESSOR MILLS IN THE CHAIR.

VISCOSITY DETERMINATIONS.

BY EDMUND J. MILLS, D.S.C., F.R.S.

In the ordinary method of determining viscosity for technical purposes, an oil or other liquid is allowed to run out of a pipette, at a definite temperature, and the number of seconds required for emptying the pipette is observed. A similar experiment is performed with olive oil, used as a standard: the number of seconds required for this being taken as 100, the proportional number of seconds required for the trial oil gives the desired viscosity.

When the ordinary temperature is the temperature of the determination, it is sufficient for technical purposes to work in a room not directly heated, and to carry out the comparison as quickly as possible. For the temperature of 100°, a very simple apparatus, illustrated in the accompanying figure, may be constructed out of materials always at hand in any laboratory. It consists, as will be observed, of a flask—a suitable capacity for which is about 500cc. This is more than half filled with water, and contains in addition, a test tube, in which sufficient lead is inserted to sink it to the bottom of the flask. From the mouth of the flask proceeds a wide tube of adequate length, and in this is placed, centrally, and without contact, the filled pipette, previously closed at the top. After steaming the pipette for a few minutes, its upper orifice is opened, the hot liquid falls gradually into the tube below, and the time for passing certain definite marks is noted. The upper mark is the ordinary graduation mark of the pipette; the lower one should be placed above or at the place where the pipette begins to taper towards its point, there being much retardation of the fall in all lower positions. The method is, in fact, always liable to grave runs if the last few drops which the pipette can hold are taken into account.



A little consideration is sufficient to show that determinations of real viscosity cannot be made in this way. When an oil runs out of a pipette much of it is the subject of mere flow, without shear; and where the viscosity of the oil is low, the relation of the number thus obtained to the actual viscosity must be of a somewhat distant kind. Poiseuille's method is the only one whereby real viscosities can be accurately obtained, but its employment, though sufficiently easy, is undoubtedly not quite so simple as the use of the pipette. The apparatus employed by Poiseuille is perfectly well known in physical laboratories, and consists, as the Section is doubtless aware, of a capillary tube of moderate dimensions (accurately measured) attached to a pipette of capacity well ascertained between two marks. The time of flow from mark to mark is observed as in the usual pipette method. The mathematical formula connecting several of the relations of viscosity was worked out empirically by Poiseuille; it has since been deduced from hydrodynamical considerations by several physicists (cf. Lamb, "A Treatise on the Mathematical Theory of the Motion of Fluids," p. 224; Cambridge, 1879). It has the advantage of being easily read in centimetre-gramme-second units. In this way, each determination of viscosity has a meaning of its own, apart from comparison; or, if a comparison be required, a list of substances can be provided for this purpose, and the same results can be obtained by different investigators, using different apparatus, and operating

in different localities. I have accordingly thought it might be useful to technologists if I were to place on record a few results obtained under fairly definite conditions. The capillary tubes had radii ranging from .0956mm. to .2545mm., a length of 71.73 to 82.16mm., and were worked at pressures under 1000mm. (water). The temperature was kept, by means of a water-jacket, as nearly as possible at 12° C. As regards the liquids examined, the ether was prepared from ethylic alcohol, the water had been recently boiled, and the remaining substances were of a high degree of purity.

If Q be the number of cubic millimetres of liquid traversing in t seconds a capillary having a radius r millimetres and a length l millimetres, under a pressure of p millimetres of water, the viscosity in absolute measure is given by the equation—

$$V = \frac{\pi t p r^4 \times 98.1}{8 Q l}$$

It is assumed that there is no slip.

The results are contained in the following table. Specific gravities at 12° C. are stated, water at 12° being unity.

VISCOSITIES AT 12° C.

Substances.	Sp. Gr.	V.	V (Water = 100).
Ether .....	.71689	.0026109	22.517
Carbonic Disulphide	1.27276	.0033937	39.681
Benzene .....	.86889	.0066458	56.739
Carbonic Tetrachloride ..	1.61033	.010622	90.686
Water	1.0000	.011713	100.000
Turpentine .....	.87100	.020788	177.18
Broxburn "885" .....	.88327	.56202	4798.3
LUBRICANTS.			
Sperm Oil .....	.88789	.68828	5876.2
Olive " .....	.92013	1.1393	9726.8
Lard " .....	.92031	1.6285	13903
Castor " .....	.96511	21.721	185410

DISCUSSION.

Mr. STANFORD, after alluding to the difficulties attendant upon viscosity determinations, invited full discussion of the paper.

Mr. PATTISON wanted to know what was the relation between the lubricating power of an oil and its viscosity. The table gave for sperm oil a viscosity of 5876.2 (water=100), and olive oil a viscosity of 9726.8, yet they preferred the former as a lubricant. Castor oil again, with a viscosity of 185,440, or about 20 times as great, had not nearly so high a market value for lubricating purposes as olive oil. Was there any relationship whatever between the two?

Mr. FYFE said that many undoubtedly bought their oils on the strength of viscosity tests exclusively. This was most misleading, for sperm oil at once suggested itself as low in viscosity, and highest in lubricating power. Nobody would accuse melted indiarubber or resin of being lubricants, notwithstanding their high viscosity. So far as the oil trade was concerned, buyers were now finding this out for

themselves. The apparatus exhibited was most interesting. The well-known defects in the apparatus at present in use had induced many minds to devote attention to the subject, and as a result they already had pendulum, air-bell, and more lately Redwood's agate viscosimeters.

Mr. TERVER, as an oil works manager, agreed with the previous speaker that it was a mistake to estimate the practical value of a lubricant by its viscosity. The author had pointed out the importance of preserving a constant temperature during these viscosity determinations. Supposing as a practical test they took one of Napier's little machines, and ran it at a very high speed with best mineral lubricating oil, they would find the oil to be little or no good, but with a burning oil of low viscosity the friction almost entirely disappeared. Again, if they heated the rubbing parts and applied the lubricating oil, its lubricating property was enormously increased, though its viscosity was diminished. Again, the very thickest and most viscous fractions of our mineral oils were perfect lubricants at a low speed, but absolutely worthless at a high one. Thus mere viscosity was no criterion of the value of a lubricant.

Mr. J. S. THOMSON said that they were indebted to the author not merely for devising a machine to test viscosities, but for showing them how to make any number of apparatuses which would give concordant results in the hands of operators, an end by no means attained by the common pipette method. They now had a formula which would enable them to reduce their results to an absolute standard. He had recently seen a process suggested for determining viscosity, by noting how long an air bubble took to rise through a given column of liquid.

Mr. T. L. PATTERSON suggested that the greater viscosity observed in the case of some of the vegetable oils of low lubricating value was due to oxidation of the oil as it passed out of the capillary tube during the determination. These vegetable oils, and especially castor oil, were very easily oxidised, and always "gummed" when applied on journals. Had the author tried any experiments in that direction?

Professor MILLS, in reply, said that, as Mr. Fyfe had pointed out, viscosity was only one factor in determining the value of oils. Durability and liability to chemical change must also be borne in mind. Cohesion and friction altered with the speed of rotation; in fact the coefficient of friction changed three times during a progressive increase in the rate of revolution from a very low rate of speed up to about 2000 revolutions per minute. Frictional alteration was not a means of valuing lubricants; thus for example tallow was far more liable to chemical change at a high temperature, but also much more viscous, than mineral oil. The suggestion that the high viscosity of castor oil was due to oxidation during the determination was entirely out of the question. Castor oil did not "gum" in an apparatus of that kind. But on the other hand, the greater viscosity of castor oil doubtless turned upon the fact that it was one-third more oxygenated than an oleic glyceride of the ordinary type. If they were to theorise about the intimate constitution of castor oil, they might suppose it to be in itself a ready gummed oil, on account of its being more highly oxygenated. Mr. Ellis and himself had been engaged for many years in carrying out a whole series of investigations on viscosities, by ascertaining the laws which regulated the ascent of hollow glass bulbs in various media. But they got far too close a scale of viscosity—i.e., the numbers were far closer together than the "Poiseuille" figures; so that in order to obtain the true viscosities which he had laid before the meeting he had had to revert to the old method of Poiseuille.

ON MAUMENÉ'S TEST FOR OILS.

BY CHAS. J. ELLIS, F.C.S.

MAUMENÉ'S* test for oils, which consists in noting the rise in temperature which occurs when an oil is mixed with strong sulphuric acid, is one of very considerable importance, and yields results of greater quantitative value than might at first be expected. A suitable weight of oil to use is 15grms.; this is weighed in a beaker of about 50cc. capacity; 5cc. of strong sulphuric acid, of 1·84 sp. gr., is then run carefully down the side of the beaker, and forms a layer below the oil. The bulb of a thermometer is then immersed in the mixture and the temperature noted. The acid and oil are then stirred together rapidly, using the thermometer as stirrer, when the temperature rises; after the mixture is complete (usually in from one to two minutes), the maximum temperature is reached, which is also noted, and the rise in the temperature for the oil in question thus obtained. In the case of oils such as olive oil, rape oil, cottonseed oil, etc., results of several experiments coinciding within 1° C. are easily obtained, and when two of such oils are mixed together the percentage of each present in the mixture can be determined—at any rate, to within a small fraction—by noting the rise in temperature which takes place on mixing the oil with sulphuric acid in the above proportions.

The object of this paper is to lay before the Section the notes of some experiments which I have recently carried out with the view of extending the application of this test to such oils as the drying oils, linseed, poppy, nut, etc., and to fish oils, to which it cannot be directly applied without some slight modification. If linseed oil, for example, is mixed with strong sulphuric acid directly, as in the case of olive oil, the action is extremely violent; the liquid froths up, and a large quantity of gas is given off, which of course carries away a great quantity of heat with it, and no standard numbers can be obtained, which would be applicable to the quantitative estimation of such oils when mixed with any of the oils to which the test is directly applicable. Evidently, then, it is necessary to mix with a drying or a fish oil some liquid which will moderate the action of the sulphuric acid upon it. The liquid I used for this purpose was a mineral lubricating oil of 915 sp. gr., and as, on mixing sulphuric acid with such an oil, a certain rise in temperature takes place, it is first necessary to determine the rise due to each gramme of the mineral oil. This I tried to do directly, but with no great success, as the action was so extremely sluggish that the mixture necessarily lost a certain quantity of heat during the experiment, as it required nearly ten minutes' stirring before the maximum temperature was reached. To accelerate the action, I mixed the mineral oil in certain proportions with colza oil, for which the standard number, when not mixed, was accurately determined, and found to be 55·8° C. It might be expected that various mixtures of these two oils would show, as rise of temperature, a mean between the rise shown by each oil separately, depending exactly on the proportions in the mixture; that is to say, supposing a mixture is taken of n grms. mineral oil and $(15-n)$ grms. colza, and that y represents the rise due to each gramme of the mineral oil, and $\frac{55·8}{15}$ the rise due to each gramme of colza, we might expect to get a total rise of $ny + (15-n)\frac{55·8}{15}$ degrees C. This, however, appears not to be quite the case; and the

smaller the quantity of mineral oil in the mixture the greater appears to be the value of y , if we suppose the rise due to each gramme of the vegetable oil to remain constant, whatever the mixture. Probably it is not exactly so, but it is convenient to credit all the discrepancy to the retarding oil, and then a simple formula can be employed which allows of the rise in temperature due to each gramme of the mineral oil being calculated:—

Let y = rise in temperature due to each gramme of mineral oil;

x = the fraction of the mixture consisting of mineral oil;

a and b = constants depending on the conditions of the experiment and the particular mineral oil employed.

Then $y = a + bx$.

I have tabulated below the results of experiments, and it is seen that the experimental value obtained for y , on the above assumption regarding the vegetable oil, agrees, within error of experiment, with the value calculated from this formula. Colza and olive were the two oils which I used, but apparently the same conclusion could be deduced from others, if the maximum temperature attained in the experiment is not allowed to exceed about 60° C., for the numbers which I have worked out for the drying and fish oils have all been calculated from experiments on mixtures containing at least two different proportions of mineral oil, and these agree tolerably closely.

TABLE I.—Mixture = 15grms. (Colza and Mineral Oil.)

x	Rise in temp.	Due to Colza.	y
—	55·8° C.	55·8° C.	—
$\frac{1}{2}$ = 5 grms.	15·0	37·2	1·560° C.
$\frac{1}{3}$ = 7·5 ..	37·75	27·9	1·313
$\frac{2}{3}$ = 10 ..	28·75	18·6	1·015
$\frac{4}{5}$ = 11·25 ..	21·1	13·95	·902

TABLE II.—Mixture = 15grms. (Olive and Mineral Oil.)

x	Rise in temp.	Due to Olive.	y
—	39·6° C.	39·6° C.	—
$\frac{1}{2}$ = 5 grms.	31·0	26·1	1·520° C.
$\frac{1}{3}$ = 7·5 ..	29·7	19·8	1·320
$\frac{2}{3}$ = 10 ..	23·1	13·2	·990
$\frac{4}{5}$ = 11·25 ..	19·75	9·9	·876

The value for a , deduced from the above experiments, is 2·116; and for b , -1·644. Table III. gives, side by side, y , calculated from the formula, and y , taken from the mean value in Tables I. and II. In the fourth column I have placed the total number of degrees C. to be deducted for the mineral oil for each value of x .

TABLE III.

x	y from $y = a + bx$	Mean experimental value of y .	To be deducted from rise for Mineral oil.
$\frac{1}{2}$	1·568	1·540	7·84
$\frac{1}{3}$	1·294	1·316	9·70
$\frac{2}{3}$	1·020	1·003	10·20
$\frac{4}{5}$	·883	·889	9·93

* Paris, *Comptes Rendus*, xxv. 1852, pp. 572–573. *Erdm. Journ. Prakt. Chem.*, lviii. 1853, pp. 26–28. *Journ. de Pharm.*, xxv. 1854, pp. 210–215.

Tables IV. and V. give the results of experiments with several drying and fish oils; Table IV. relates to mixtures containing $\frac{1}{3}$ of the oil in question and $\frac{2}{3}$ of mineral oil; Table V. to mixtures containing $\frac{1}{4}$ of the oil in question and $\frac{3}{4}$ of mineral oil, the total weight of the mixture used being, of course, 15 grms. In the third column I have placed the maximum temperature attained, as, in almost all the experiments, I found that the higher the maximum temperature the higher the value for each gramme of the oil in question, and that when the maximum temperature was much over 60° C. no concordant results could be obtained, which seems to indicate that above that temperature further reactions set in between the sulphuric acid and the oil. It is therefore of importance that the mixture should be made in such proportions that the highest temperature attained may be below 60°—in fact, it is well to keep it even below 50°. This can easily be managed by making a preliminary trial of the quantity of mineral oil to use. All these numbers are the means of several determinations agreeing fairly closely.

TABLE IV.

NAME OF OIL.	Rise in temp. —10° 2° for Mineral oil.	Maximum temp.	Rise due to each gramme of oil in question.
Linseed (raw) . . .	39.1	60°	7.82
" (boiled) ..	33.8	55	6.76
Poppy-seed	22.3	46	4.46
Nut oil	25.6	45	5.12
Scotch cod-liver ..	38.0	56	7.60
" skate-liver..	39.5	58	7.90
" ling-liver ..	30.3	51	6.06
Haddock-liver	38.0	60	7.60

The bromine absorptions (with the exception of the two linseed oils and the nut oil, which were specially determined for this paper) are taken from papers by Dr. Mills, on "The Quantitative Estimation of Fats and Oils," and on "Bromine Absorptions" (this Journ. pp. 366—368, 1884, and pp. 96—98, 1885). Besides the above oils, I made a test of a good average sample of rosin oil. This was determined without admixture of mineral oil, and the rise for each grm. found to be 1.53°.

In order to test the practical value of the above numbers for determining the quantity of two oils in a mixture, I had mixtures made up for me by another, the percentage composition of which I was not told till after returning the results obtained by experiment. Two mixtures of two oils each were given me, the first consisting of cod-liver and ling-liver oils. This I examined by Maumené's test, using a mixture of the oil with twice its weight of mineral oil added, and found it contained 43.3 per cent. cod-liver and 56.7 per cent. ling-liver, the actual mixture being 41.7 per cent. cod-liver, and 58.3 per cent. ling-liver. The other mixture was colza and raw linseed. On testing this mixture with twice its weight of mineral oil added, I found 31 per cent. linseed and 69 per cent. colza, and with three times its weight of mineral oil added, 30.9 linseed and 69.1 colza, the actual mixture being 29.9 per cent. linseed and 70.1 per cent. colza. It is hardly necessary to mention, in conclusion, that y , a , and b in the formula ($y = a + b.r$) must be specially determined by experiment for any particular mineral oil which is to be used as retarding agent, and that if the numbers given are used as standards, the conditions of the experiment must be strictly adhered to.

DISCUSSION.

MR. TERVET asked if allowance had been made for the relative specific heats of the oils experimented upon? Mineral oil had a very low specific heat as compared with certain animal and vegetable oils;

TABLE V.

NAME OF OIL.	Rise in Temperature—9° 95 for Mineral Oil.	Maximum Temperature.	Rise due to each Grm. of Oil in question.	Bromine Absorption.
Linseed Raw	28.57	48°	7.62	81.25%
Linseed Boiled	24.87	46°	6.63	81.50
Poppy-seed	17.32	37°	4.62	56.51
Nut Oil.....	17.99	35°	4.80	72.74
Cod-liver.....	27.82	48°	7.42	81.61
Skate-liver.....	29.77	48°	7.91	109.20
Ling-liver	22.07	41°	5.88	82.44
Haddock-liver	27.57	49°	7.35	109.84

It will be noticed that in most cases the numbers in Table V. are slightly lower than in Table IV., the maximum temperature being also lower. Poppy-seed oil and nut oil were most affected by a change in maximum temperature, and it was extremely difficult to obtain concordant results with those oils at different temperatures. I tried mixtures of half mineral and half of each of these oils, and the numbers were considerably higher than the above. Cod-liver, skate-liver, and haddock-liver oils show approximately the same numbers; but ling-liver distinctly lower. At the commencement of the mixing of the acid with the fish oils, a purple colour is noticed, which soon changes to brown. This purple colour is particularly intense in the case of ling-liver.

and if one of these latter were mixed with various proportions of mineral oil, the amount of heat generated must vary in proportion to the amount of mineral oil present. For instance, if in one experiment colza and A proportion of mineral oil were taken, then the resulting temperature ought to be different from that obtained when colza and B proportion of mineral oil were mixed together.

MR. STANFORD asked what was the range of temperatures in these mixtures, at least some of the more important ones?

MR. McARTHUR asked what action took place between sulphuric acid and these vegetable oils? Did the amount of heat generated depend on the amount of oxygen in the oil; and why was colza oil used as

a medium? Would not water do to dilute the sulphuric acid with?

Mr. J. S. THOMSON pointed out a feature in the analysis of fatty oils which the author had not touched upon. No doubt his modification of Maumené's test enabled him to deal with mixtures of two known oils. But suppose they were given a sample of rape or seal oil, stated generally to be adulterated, the question would at once be what the adulterant was, and until that was settled the test would be useless. He knew of no method which would enable them to determine the relative proportions of two oils, the very nature of which was unknown.

The CHAIRMAN said that the author's paper certainly put Maumené's test for oils on a more satisfactory footing, and his modification enabled them to class oils which hitherto the test had failed to deal with. By adopting this expedient of diluting the oil, he had succeeded in obtaining temperatures by which he could ascertain within about 2 per cent. the composition or admixture of two oils not mixed by himself. This was a most important result, for he had thus given precision to a test which had heretofore materially lacked it.

Mr. ELLIS said: In reply to Mr. Tervet's remarks, I do not see that different oils having different specific heats has much to do with the matter in hand. It is a simple fact that a given rise in temperature results when any particular oil and strong sulphuric acid are mixed in given proportions. Of course the specific heat of the oil in question is one factor in the cause of the particular rise for that oil; but the effect is all that the test is concerned with. I have specially stated, at the end of the paper, that if the numbers given are used as standards, the exact conditions of the experiment must be adhered to. It will be seen from the tables, that in the case of such oils as this paper deals with, the rise in temperature per grm. is less as the proportion of retarding oil in the mixture is greater. Mr. Stanford asks me to give one or two numbers showing the range of temperature in the experiments. The maximum temperature in any experiment was 69° C., the initial temperature being somewhere about 10° in all the cases; the greatest range of temperature was therefore about 59° , and the least was about 27° . It is perfectly easy to get two experiments with a given mixture coinciding within from a half to one degree C. To answer the first of Mr. McArthur's questions would be rather a lengthy matter. As to the second, diluting the acid would hardly be a suitable method of procedure, for the action of dilute sulphuric acid on oils is materially different from that of strong, and in most, if not in all cases, the use of dilute acid would cause too trifling a rise in temperature to serve as a test of any degree of accuracy. I agree with the gentleman who spoke last, that the qualitative tests for oils, as at present known, are as a rule extremely poor; but from evidence gained by applying several quantitative tests to any mixture containing not more than two, or at most three oils, which is generally the case in practice, a very fair idea of what the various oils in the mixture are, can generally be obtained. However, this paper does not profess to deal with the qualitative testing of oils, but is merely an extension of one of the more useful quantitative tests.

ON THE ESTIMATION OF ALUMINA AND OXIDE OF IRON IN MINERAL PHOSPHATES AND MANURES.

BY ROBERT T. THOMSON.

THIS process is in a somewhat unsatisfactory condition, and this is chiefly due to the ignorance which

prevails with regard to the composition of the phosphates of aluminium and iron, which are precipitated in the ordinary method of determination. The following investigation was made with the view of ascertaining the best process of determining these compounds in the phosphates of commerce. It will be desirable to consider first the methods of separating the phosphates of aluminium and iron from acid solutions containing these bodies, in conjunction with phosphate of lime.

Ammonium Acetate Method.—This is the chief or only method extensively in use for the separation of alumina and oxide of iron from phosphates of lime, etc. Dr. James Bell ("Chemistry of Foods," Part II.) has objected to the operation being conducted in the cold, on the plea of incomplete precipitation. As the result of many experiments I have never had a single case of the precipitation being defective in the cold, except where there was a great deal less phosphoric acid present than was required to form normal aluminium phosphate. This being the case it would seem advisable to adhere to precipitation in the cold, or at most only warm solution, seeing that phosphate of lime is easily enough carried down, without increasing this facility by resorting to an aimless boiling. In the experiments which I shall quote this method was employed in the following manner: To the acid solution to be tested, which varied from 100 to 200 cc. in bulk, ammonia was added, till a slight cloudiness was produced, and then 50 cc. of ammonium acetate solution, which had been previously mixed with 5 cc. of ordinary acetic acid. The ammonium acetate was prepared by neutralising a quantity of the acetic acid referred to (containing about 40 per cent. $C_2H_3O_2$), with ammonia, of sp. gr. 94. The mode of washing the precipitate will be described further on.

Neutralisation Method.—I have named this the neutralisation method, because it consists in simply adding to the acid solution of the mixed phosphates, ammonia, soda or potash, until neutral to lakmoid paper. In a paper published about two years ago, I incidentally called attention to the fact that when an acid solution containing the phosphates of aluminium, iron, and calcium was neutralised with caustic soda, using methyl orange as indicator, the two first-named compounds were precipitated. When these are present in considerable quantity, it is almost impossible to get a good end-reaction with methyl orange, but I have found that the neutralisation can be effected with great accuracy when blue lakmoid paper is employed. The best way to proceed is to neutralise the most of the free acid with dilute ammonia (about sp. gr. 97), then drop half normal ammonia from a burette till the blue colour of the paper is unchanged, or shows only a faint alteration towards purple, when immersed in the mixture for a minute or two. At this point the phosphates of aluminium and iron are entirely precipitated, while the most acid phosphates of calcium ($CaH_2(PO_4)_2$), magnesium, ammonium ($NH_4H_2PO_4$), sodium and potassium (if all are present), remain in solution.

Composition of the Aluminium Phosphate Precipitate.—Having now described the methods of precipitation, the next step is obviously to determine the composition of the phosphates thus obtained, and we will first consider that of the aluminium phosphate. Experiments were made by dissolving varying quantities of ordinary phosphate of sodium of known strength, in water, adding a little hydrochloric acid, and 1 grm. of pure ammonia alum, in which the alumina had been determined by precipitation with ammonia. The solutions thus obtained were now precipitated in the cold by the two methods described above, filtered, and washed first with cold, and then thoroughly with hot water. After washing several

times with water, the filtration became tedious, and the precipitate partially lost its gelatinous form. The highest weight of precipitate obtained, even with ten times more phosphoric acid than was required to form normal aluminium phosphate, was 2491, instead of 2700gm., had pure $Al_2P_2O_5$ been weighed. Similar results were brought out when the precipitate was washed with dilute ammonium acetate, although the presence of the ammonium salt enabled the precipitate to retain its gelatinous condition, and made the filtration much more speedy. The following were the results:—

Ammonia alum used 1grm.
= Al_2O_3 2135 „
= $Al_2P_2O_5$ 2700 „

Equivalents of P_2O_5 added.	Weight of Al Phosphate precipitate.	Method of Precipitation.
1	2460gm.	ammonium acetate.
5	2491 „	„ „
1	2465 „	neutralisation.
2	2482 „	„
5	2490 „	„

Considering that these results are tolerably close to each other, I at first drew the conclusion that a basic phosphate of aluminium, of fairly constant composition, was precipitated, even when a large excess of phosphoric acid is added. But this idea had to be rejected when I afterwards found that pure water had a dissociating action on precipitated aluminium phosphate, and that the washings came away slightly but distinctly acid, long after the excess of phosphoric acid employed could reasonably be expected to be washed away. An experiment with 1grm. of alum was made to prove this. The precipitation was effected by the neutralisation method, and only about four-fifths of the phosphate of sodium required to form normal phosphate with the alumina present was added. The filtrate (about 100cc) contained about 6milligrams. of P_2O_5 , and the precipitate was washed several times with hot water to remove any traces of acid phosphate of sodium or ammonium that might remain. The washing was then continued with hot water, until half a litre of filtrate was obtained, and the phosphoric acid determined. The results showed 21milligrams. of P_2O_5 , but alumina could not be detected. The composition of the precipitate was basic to start with, and had it been purely normal, the action of the water would probably have been greater.

The next series of tests was made by the two methods, but the washing was effected with a cold, then a hot one per cent. solution of ammonium nitrate, containing an amount of di-acid ammonium phosphate ($NH_4H_2PO_4$) equal to 05gm. of P_2O_5 per litre, then giving a final single wash with pure water, which would practically remove the phosphoric acid in solution, and not affect the composition to an appreciable extent. The phosphoric acid was estimated in a portion of the filtrate obtained by washing the precipitate, and the proportion found agreed with that really present in the original solution. It was thus apparent that the latter was without action on the aluminium phosphate precipitate. The following are the results:—

Equivalents of P_2O_5 added.	Weight of Al Phosphate precipitate.	Method of Precipitation.
1.5	2606	neutralisation.
2	2695	„
5	2704	„
2	2702	ammonium acetate.

These results show that if at least two equivalents of P_2O_5 and one of Al_2O_3 are present together, normal aluminium phosphate ($Al_2P_2O_5$) is precipi-

tated, but can only be retained in that condition by the mode of washing suggested. The compound formed in presence of two equivalents of phosphoric acid was analysed, and gave the following figures:—

	$Al_2P_2O_5$ Precipitate.	Theoretical Composition of $Al_2P_2O_5$.
Al_2O_3	43.65	42.04
P_2O_5	56.70	57.96
	100.35	100

The phosphoric acid was determined by the combination of the molybdate and magnesia methods, and the alumina was estimated in the molybdate filtrate by precipitation with a slight excess of ammonia.

I may also notice at this stage another method of precipitating aluminium phosphate. This is also a neutralisation method, but is the reverse of that already described, and consists in adding hydrochloric acid to a caustic soda solution of alumina and phosphate of sodium, until neutral to lakmoid paper. An experiment with one equivalent of P_2O_5 to one of Al_2O_3 gave 2380gm., and with two equivalents 2505gm. of aluminium phosphate, instead of 2700 gm. It would thus appear that even with two equivalents of phosphoric acid a basic compound is formed, and it would no doubt be unsafe to use this method of neutralising, even if more phosphoric acid would give rise to a normal compound.

Composition of the Iron Phosphate Precipitate.—All the remarks made with regard to the aluminium phosphate apply to the analogous iron compound. The precipitate is also decomposed when subjected to hot-water washing, and requires the same washing with ammonium nitrate solution, containing a minute quantity of di-acid ammonium phosphate, to enable it to retain the normal condition. The following are the results of experiments made with 1grm. of pure iron alum ($Fe_2(NH_4)_24SO_4 + 24H_2O$), using different proportions of sodium phosphate, and precipitating by both methods:—

Iron alum used 1grm.
= Fe_2O_3 1660 „
= $Fe_2P_2O_5$ 3133 „

Equivalents of P_2O_5 added.	Weight of Fe_2 Phosphate precipitate.	Method of Precipitation.	
1	2756gm.	neutralisation.	} washed with water.
5	2980 „	„	
1	2770 „	ammonium acetate.	
1	2985 „	neutralisation.	
1.5	3125 „	„	
5	3134 „	„	
1.5	3130 „	ammonium acetate.	
5	3137 „	„	

The precipitates of the last five experiments were washed with the ammonium nitrate and phosphate mixture. It is obvious that those obtained with 1.5 (and upwards) equivalents of phosphoric acid are purely normal phosphate of iron ($Fe_2P_2O_5$). One of them was analysed, and gave:—

	$Fe_2P_2O_5$ Precipitate.	Theoretical Composition of $Fe_2P_2O_5$.
Fe_2O_3	53.05	52.98
P_2O_5	46.82	47.02
	99.87	100

Effect of Metallic Salts.—Two experiments were finally made by both precipitation methods, in order to observe whether the presence of metallic salts, other than those of ammonium, sodium and potassium, had any effect on the accuracy of the results. The determinations were made in both cases with a mixture of 25gm. ammonia alum, 25 iron alum, 5

manganese sulphate, 5 zinc sulphate, 5 calcium chloride, and 5 of magnesium sulphate. The precipitates should weigh, if nothing else were carried down, 1458 grm. By the neutralisation method, 1523 grm. was obtained, and this is not so very far out, as it contained a little manganese, which could be removed by dissolving and reprecipitating. By the acetate of ammonia process the precipitate weighed 2726 grm., or nearly double the correct weight, and it contained both manganese and zinc. Neither of the precipitates contained appreciable quantities of lime or magnesia. It is evident that the ammonium acetate process would be useless in presence of manganese or zinc, but that the neutralisation would effectively separate these metals. I had not time to make confirmatory quantitative experiments on this part of the subject; but qualitative tests showed that on mixing sulphate of manganese or zinc with phosphoric acid, a precipitate was produced on addition of ammonium acetate; but no effect was observed on neutralising with ammonia, when lakmoid paper was employed as indicator, the addition of alkali being stopped when the paper showed a slight change to purple.

Summary of Determination of Alumina and Oxide of Iron in Commercial Phosphates.—Two or three grms. may be taken, dissolved in hydrochloric acid, evaporated to dryness, the residue dissolved again in hydrochloric acid, diluted, and filtered. The phosphates of aluminium and iron are then precipitated, either by ammonium acetate or neutralisation, as described at the outset of the paper. The large excess of acetic acid used in the former case may be objected to, but only by its influence can all the lime be removed. It has no effect on the precipitates. The precipitate is then collected on a filter, and washed several times with cold one per cent. solution of ammonium nitrate containing di-acid ammonium phosphate ($\text{NH}_4\text{H}_2\text{PO}_4$), equivalent to 0.5 grm. P_2O_5 per litre. It must then be thoroughly washed with the same solution (hot), and finally once with pure water, then dried, ignited, and weighed. It may then be dissolved in hydrochloric acid, reduced with protochloride of tin, and the iron determined by standard potassium bichromate. The result is calculated to $\text{Fe}_2\text{P}_2\text{O}_8$, which is subtracted from the weight of the precipitate, and the remaining $\text{Al}_2\text{P}_2\text{O}_8$ calculated to alumina. The following results were obtained by mixing about 3 grms. of $\text{Ca}_3\text{P}_2\text{O}_8$, with varying quantities of ammonia alum and iron alum, and determining the alumina and oxide of iron as described:—

Grm. of Al_2O_3 used.	Grm. of Al_2O_3 found.	Grm. of Fe_2O_3 used.	Grm. of Fe_2O_3 found.
*0341	*0352	0332	0339
*0341	0348	0498	0500
*0341	*0346	0498	0499
*0568	*0580	0830	0835
*0568	0578	0830	0835

Those marked with an asterisk were done by the neutralisation method.

If a high result is apprehended from the precipitation of phosphate of lime, the precipitate may be dissolved in hydrochloric acid, excess of caustic soda added, boiled, and filtered. The iron can then be determined by a volumetric process in the insoluble, and the alumina determined in the filtrate, after acidifying with hydrochloric acid, by either of the methods described above. It would be well, however, to add some phosphoric acid or phosphate of ammonium, to ensure the presence of an excess of the former sufficient to produce normal aluminium phosphate.

Dr. Clark has mentioned to me that in certain

mineral phosphates containing fluoride of calcium, he could not get the precipitated phosphates free from lime, even after redissolving and reprecipitating. This he thinks is possibly due to the precipitation of fluoride of calcium, which might not be decomposed by evaporation with hydrochloric acid. I have found that a mixture of chloride of calcium and hydrofluoric acid does give a gelatinous precipitate with ammonium acetate. Of course, this interference of fluorides can be obviated by first heating the weighed portion of the sample with strong sulphuric acid till these compounds are decomposed, and all the hydrofluoric acid is expelled. The residue may then be treated with hydrochloric acid, and the determination proceeded with.

Addendum.—Since writing the above paper, the author has made experiments with reference to washing the phosphates of aluminium and iron with cold water, and finds that the latter has also a dissociating action on these compounds. The experiments are also being carried out with mineral phosphate of alumina, etc.

DISCUSSION.

Mr. HENDERSON understood the author to state that precipitated phosphates of aluminium and iron were decomposed when washed with boiling water, phosphoric acid being carried away in solution, and basic phosphate left behind. Did this decomposition go on indefinitely, or did it cease when a stable basic phosphate of definite composition was reached?

The CHAIRMAN asked how far this dissociation of phosphates was likely to occur in soils? Did it increase materially as the water grew hotter; for if it took place in the cold it would be of considerable importance to agriculture, in connection with the manurial values of iron and aluminium phosphates, and their exhaustion.

Mr. THOMSON, in reply, said that these were points to which he would direct future experiments.

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Meeting held at Cardiff, February 14, 1886.

THE ESTIMATION OF SULPHUR IN COAL AND COKE.

BY ALEXANDER J. ATKINSON.

THE estimation of sulphur, whether in coal or coke, or in sulphur compounds, resolves itself in most cases into the conversion by a process of oxidation of the sulphur into a soluble sulphate, from the solution of which it is precipitated by the addition of barium chloride. Hence in the mode of precipitation little opportunity is offered for modifications, but in the modes of oxidation many variations have been suggested. The methods of oxidation hitherto adopted may be grouped into three classes according to the nature of the oxidising agent employed—viz.: 1st.

Oxidation by means of *solid* oxidising agents—*e.g.*, potassium nitrate or potassium chlorate; this mode of oxidation is that commonly known as the *Deflagration Method*, and is the principle hitherto most commonly adopted in the estimation of sulphur in coal and coke; 2nd. Oxidation by means of *liquid* reagents—*e.g.*, fuming nitrate acid or *aqua regia*; this is the principle of a method advocated by Dr. Lunge, and now extensively adopted for the determination of sulphur in pyrites; 3rd. Oxidation by *gaseous* reagents, notably oxygen as contained in atmospheric air. This last-named mode of oxidation is finding more and more favour with chemists who have to make many determinations of sulphur in coal or coke owing to the readiness with which the various steps are carried out.

As methods falling under the two first of the above-named headings have already been fully described by previous writers, and as they have little in common with the modified method presently to be submitted, it is needless to dwell upon them here further than to remark that, although in careful hands exceedingly accurate results may be obtained by their adoption, yet all these methods require unremitting attention during the oxidation stage, and are otherwise more dependent upon minute precautions than methods based upon the oxidation by atmospheric oxygen.

As far as the writer has been able to trace the history of this subject, it appears that the first suggestion to employ a gaseous oxidising agent was made in the year 1874 by Herr Eschka,* who described a method by which to oxidise the sulphur in the coal—by ignition in a platinum crucible over a spirit-burner—of a mixture of the coal with calcined magnesia and sodium carbonate. Eschka appears to have considered that the oxidation to the state of sulphuric acid was incomplete, for he recommends the subsequent addition of ammonium nitrate and further ignition in order to complete the oxidation.

In the same year as Eschka's method appeared, Mr. W. F. K. Stock† published his method based upon the use of calcium hydrate as the absorbent of the sulphuric acid formed. It is here proposed that the weighed portion of coal be mixed with an equal weight of slaked lime, moistened with water so as to form a thin paste, the moisture dried on a hot plate, broken into a coarse powder by grinding in the crucible, and then heated in a muffle to bright redness. After ignition, the capsule is allowed to cool, ammonium nitrate added, the mixture again dried and ignited. After cooling, the mass is dissolved in dilute hydrochloric acid, filtered, and in the filtrate the sulphur is precipitated as barium sulphate.

A few years later, in 1879, a Japanese, Mr. T. Nakamura,‡ contributed to the Chemical Society a method of oxidation by means of atmospheric oxygen, in which the use of calcium hydrate as an absorbent of the sulphuric acid formed is replaced by that of sodium carbonate, while the combustion of the carbon is effected at a dull red-heat over a spirit lamp. This is, in principle, the method which has recommended itself best to the writer, who now proposes to deal with the few modifications which he has found well to introduce. The difficulty with which the heat from a spirit lamp can be evenly distributed over the whole of the test suggested to the writer that the combustion could be more easily conducted in a muffle through which a gentle current of air is made to pass. Several experiments were made with such satisfactory results that the deflagration

method, adopted until then, was abandoned in favour of the method which now, after about six years' working, I propose to introduce to the notice of members of this Society.

As it is necessary that the coal or coke to be examined should be in a state of extreme fineness, it should, after drying at 100° C., first be ground in an iron mortar until it will pass through a sieve of 120 meshes to the linear inch, then thoroughly well mixed, and from it a portion taken somewhat in excess of that required for a duplicate test; this portion is then to be ground in a Wedgwood or iron mortar until no feeling of grittiness is perceptible, then dried in a good desiccator, and from it two test portions of respectively 1.0 grm. and 1.2 grm. weighed out. Each of these test-portion is then intimately mixed, by grinding in a mortar with a weighed quantity (5 grms. and 6 grms., respectively) of redried pure anhydrous sodium carbonate. This mixture is next introduced into a flat platinum dish, spread evenly over the bottom of the dish, and placed on a rectangular rest made of clay-pipe stems inside a muffle, which, though hot, is still black. Before introducing the test into the muffle, the operator should so arrange the fire that the heat will rise gradually in about half-an-hour from blackness to clear cherry-redness—it should not be allowed to rise so high as to sinter or fuse the sodium carbonate—and at a clear cherry-red heat the test is allowed to remain for ten or fifteen minutes; at the end of this time all the carbon, and with it all the sulphur, will be found to have been burnt, the passage of a constant current of air through the muffle being insured by a slit at the back of the muffle. It is unnecessary—indeed, undesirable—to stir the test during ignition, and with a muffle well under control the operation requires no attention during the forty-five minutes that the test is in the muffle. At the end of this time it will be found that the sulphur has been entirely oxidised and absorbed by the sodium carbonate, a portion of the carbonic acid giving place to sulphuric acid, no addition of ammonium nitrate being necessary for complete oxidation. The ignited sodium carbonate, mixed with the resulting sodium sulphate and coal-ash, is now brought into a small beaker, the last traces being washed into the beaker from the platinum dish, and water added, the volume of liquid being 120 to 150 cc. Solution is aided by heating and agitation, and when all soluble matter is dissolved, the beaker is allowed to stand on a warm part of the hot plate until the insoluble matter has settled. The clear solution is now passed through a small Swedish filter into a beaker with high sides; the insoluble matter is washed twice by decantation with hot water, a few drops of a solution of pure sodium chloride being added at each washing in order to avert the tendency of the finely divided ash to pass through the filter. After washing by decantation, the insoluble matter is rinsed on to the filter, and carefully washed with water and sodium chloride three or four times, until a small portion tested with barium chloride gives no precipitate. The filtrate containing all the sulphuric acid is acidified by the addition of 10 to 15 cc. of pure hydrochloric acid, carefully added with the aid of a pipette, and the whole boiled in order to expel free carbonic acid. To the boiling solution a hot solution of pure barium chloride is added, and under these conditions the sulphuric acid is precipitated as barium sulphate in a form in which it rapidly settles. After standing for an hour or an hour-and-a-half, the barium sulphate will have completely settled, and the clear liquid can be poured through a Swedish filter. During the operation of washing this precipitate, the use of a

* Oesterreichische Zeitschrift, xxii. p. 111, and Chem. Central-Blatt, 3. Folge 5, p. 301.

† Chemical News, vol. xxx. p. 211 (1871, Nov. 6).

‡ Journal Chemical Society (1879), vol. xxx. p. 785.

small quantity of a solution of ammonium chloride is to be recommended, as this precaution prevents the precipitate passing through the filter, as will otherwise sometimes happen. When washed free from sodium salts the precipitate of barium sulphate may be dried and ignited in the customary manner.

By following this mode of procedure the author has been able during several years to obtain results which, in point of concordance, leave nothing to be desired; and, as these results agree closely with those obtained by the delagration method when carefully conducted, it is probable that where a muffle is available, the greater simplicity of this method will favour its exclusive adoption. There are, however, in the choice of reagents a few precautions which it may be advisable to point out. Experience seems to show that it is perfectly impossible to purchase sodium carbonate absolutely free from sulphate. The sample most nearly approaching this state of purity that we have been able to obtain, is the granulated salt sold by Messrs. Hopkin & Williams. 10 grammes of this salt dissolved in water, acidified with pure hydrochloric acid, boiled and treated with barium chloride gave at first no precipitate, but after standing overnight, a precipitate of barium sulphate had deposited, and this, when collected, was found to weigh 5.2 mg. It is for this reason that weighed quantities of the sodium carbonate are always used, so that the barium sulphate derived from this source may be deducted from the whole weight obtained. It is necessary that the granulated sodium carbonate be finely ground and redried, for unless all hygroscopic moisture is removed a spitting from the open dish takes place, giving rise, of course, to a loss of the test. We experience no difficulty in obtaining hydrochloric acid perfectly free from sulphuric acid, although, until confidence in the purity of the purchased acid is established, an examination ought always to precede the use. Owing to the extreme fineness of the state of division of the coal used, the residual ash is also extremely finely divided, and consequently has a great tendency to pass through even the closest Swedish filter paper, particularly after the greater part of the sodium salts has been removed by washing. In practice, therefore, it became necessary to adopt some means of counteracting this tendency; the use of ammonium chloride in washing barium sulphate precipitates suggested its use here also; this salt prevented the passage of the residue through the filter, but was objectionable on account of ammonia gas being liberated through the decomposition of the salt; a solution of sodium chloride next suggested itself as a probable remedy, a small addition to the large quantity of sodium salts being of little consequence, and the addition of this salt was found to completely prevent the passage of the residue through the filter. Sodium chloride is, however, very difficult to purchase perfectly free from sulphate, and consequently it was found to be advisable to prepare the pure salt in the laboratory, by passing hydrochloric acid gas into a strong solution of table salt. The sodium chloride thus precipitated was then filtered, well washed and dried, and when examined was found to be free from sulphate. It would, of course, be possible to determine the amount of sulphuric acid in the purchased salt, and, by using weighed quantities, to make the necessary correction; but, in the writer's opinion, it is undesirable that the calculations should be complicated by too many such corrections, especially when this can be avoided by so simple a preparation as that of pure sodium chloride.

The advantages, which the method just described presents over that described by Eschka are, that one reagent suffices in the place of three used by that chemist, thus diminishing the risk of deriving sul-

phuric acid from the reagents, that a large amount of insoluble matter—*e.g.*, magnesia, is avoided, and that the solution from which the sulphuric acid is to be precipitated is kept free from nitrates. Over Stock's method it has the advantage that the sulphate formed is readily soluble in water, and, by thus avoiding the necessity of dissolving in hydrochloric acid, the presence of iron and calcium salts in the solution is avoided; it being well known that ferric chloride, when present, together with hydrochloric acid, prevents the complete precipitation of the barium sulphate. As the method described in this paper professes to be merely a modification of Mr. Nakamura's method, by which a more complete combustion of the coal can be ensured, it cannot, from a chemical point of view, be said to have any advantages, but was necessitated by the difficulty found when using a spirit lamp, in completely burning the coal on the surface of the test, without, at the same time, fusing a portion of the sodium carbonate. A coal-gas burner cannot well be used, as the sulphuric acid, formed by the combustion of sulphur compounds in the gas, is, in part, absorbed by the sodium carbonate, and reckoned in the results.

As examples of the concordance of duplicate results, the following taken from our laboratory-book may be quoted:—No. 1, 1.30 and 1.29 per cent. sulphur; No. 2, 0.997 and 0.995 per cent.; No. 3, 1.68 and 1.72 per cent.; No. 4, 0.61 and 0.61 per cent.; No. 5, 0.762 and 0.760 per cent.; No. 6, 0.861 and 0.860 per cent.; No. 7, 0.872 and 0.855 per cent. These figures will suffice to show that concordant results may be obtained by this method; in fact, experience shows that a difference, exceeding 0.05 per cent., should never be met with; they do not, however, afford members an opportunity of instituting a comparison between the results obtained by this method and those given by other methods, and the writer regrets that he is unable to submit figures showing the comparative accuracy of the several methods in use. The comparative tests were made without any intention of the results being published, and the figures, if preserved, are in the laboratory-books of a company whose service the writer left some years ago. Not having had an opportunity of repeating the comparison, I must content myself with mentioning the case of a sample of coke sent me by a friend. By adopting the above method I found the coke to contain 1.14 per cent. of sulphur; and when I next saw my friend I learnt that his determination by the delagration method was precisely the same, 1.14 per cent.

This concludes what I have to say regarding the estimation of sulphur in coal and coke, but if members will allow me, I should like to indicate a direction in which this method may perhaps be extended. Having obtained such satisfactory results when practising upon coal, I ventured to hope that the sulphur contained in pyrites might also be determined by this method, and I have made many experiments with the object of proving the applicability of the method to this kind of analysis, but I regret to say that the results have been far from satisfactory. By finely grinding the pyrites, and mixing with about twenty times its weight of sodium carbonate, I could not obtain results giving more than 96 per cent. of the sulphur contained in the pyrites, as found by the method advocated by Dr. Lunge. By using a larger quantity of sodium carbonate it was thought that a more complete absorption of the sulphuric acid could be effected, but experiments proved the contrary. In order to find whether a portion of the sulphur had been only partially oxidised, the test, after ignition, was treated with bromine, but without obtaining any higher results. The residual ferric oxide was also examined,

but it was found that all the sulphur had been removed during the ignition in the muffle.

Hitherto the writer has been baffled in his attempts to work out the estimation of sulphur in pyrites upon these lines, and is induced to mention his experience in the hope that some other person may more completely grasp the details, and give chemists the benefit of his results. If by some simple device the complete absorption of the sulphuric acid could be secured, the amount of this sulphuric acid might be determined by finding the quantity of standard sulphuric acid required to neutralise the excess of sodium carbonate, and deducting that amount from the quantity which would be required to neutralise the whole of the sodium carbonate weighed out. In this way a ready volumetric method of estimating sulphur in pyrites could be found, which should be accurate enough for technical purposes, and which could be completed within two-and-a-half hours from the time of receiving the crushed sample.

Obituary.

H. SUGDEN EVANS.

HENRY SUGDEN EVANS, born May 19th, 1830, was the youngest son of John Evans, founder of the firms of Evans, Lescher & Webb, of London, and Evans, Sons & Co., of Liverpool, wholesale and export druggists. Educated at the Merchant Tailors' School, and under Dr. Whitehead, of Ramsgate, he was early apprenticed to his father's business in Bartholomew Close. In 1847 he entered as a student at the Pharmaceutical Society, and passed all the examinations, which were at that time voluntary. In 1849 he was elected a Fellow of the Chemical Society. He assisted in the formation of the "Liverpool Chemists' Association," of which he was twice president (1857—1858); and he was also identified with the formation of the "Liverpool Natural History and Microscopical Society." In 1860 he was elected a member of the Council of the Pharmaceutical Society, becoming president in 1869. He represented the Pharmaceutical Society at the International Congress in Vienna, in 1868, and in 1873 served as a juror on Food at the International Exhibition in that city. In 1870 he was awarded the diplomas of the Pharmaceutical Societies of Vienna and St. Petersburg, and was elected a vice-president of the Royal Microscopical Society. He proceeded, in 1879, to Canada, to conduct a branch of his business at Montreal, and in 1884 he retired from mercantile affairs, and accepted the appointment of Chief Analyst to the Dominion. He also established a private practice as a consulting analyst at Ottawa.

In February last he went on Government business to Boston and New York, and it was at the latter place that he was seized with an attack of pneumonia, which proved fatal on the 23rd. His kindness of disposition endeared him to all who knew him, and his loss is deplored by a large circle of friends. His death is also an unquestionable loss to the Dominion Government.

THE RIVERS PURIFICATION BILL.*

From the Manchester Guardian, March 18, 1886.

SIR E. BIRKBECK moved the second reading of this bill on Tuesday night, 16th March.

Sir H. Roscoe, in moving that the bill be read that day six months, said that he did this in no unfriendly spirit to river purification. The importance of the subject of river pollution and its amelioration was one with which hon. members were well aware, and at that late hour he would not trouble the House by any historical survey. He opposed this bill because he was desirous of having a practicable workable scheme in place of this, which he characterised as quite the reverse, being complicated, impracticable, and dangerous, as imperilling the very existence of many of our most important industries, and that at a period of unexampled depression. He desired to point out to the House that whilst the Act of 1876 discriminated between the pollution caused by sewage and that produced by manufactures and mines, no such distinction is drawn in this bill. Such a distinction was, however, absolutely necessary, for whilst sewage impurity had everywhere approximately the same composition, and was therefore capable of treatment by similar methods of purification, manufacturing pollution was of the most varied character, as was seen in the case of breweries, paper works, alkali works, dyeworks, etc. So that not only were the methods which should be employed for purification different, but the standards according to which the purity is to be judged must also be different. In the present bill every kind of pollution was to be judged by one set of standards, and hence these could not but prove inefficacious, being in some cases either so strict as to place a hindrance on industry, or so lax as to be practically worthless. If any progress was to be made with legislation on this important question, the subject must be attacked piecemeal, and this bill was far too sweeping in its provisions. Science was now in a position to deal satisfactorily with sewage. At a certain cost it could be so treated that the effluent was made inoffensive, and therefore there could be no objection to legislation on this subject. But as regarded manufacturing pollution, the same could not be said, and the only method was to apply the best practicable means which was found in the Act of 1876, but was not referred to in the bill now before the House. Then, again, not only were all trades treated alike as regards pollution, but all rivers were placed under the same set of standards, the only difference allowed being between those used for drinking purposes and those not used for drinking. This was an altogether impracticable plan; it was absolutely necessary to consider each river on its merits, and to treat the subject geographically, for the circumstances of each river, or even of each part of a river, were different, and required different treatment. Hence, he thought that this great and important subject was one which could not be properly treated in a private bill, but should be considered by Government. On the part of the manufacturers interested in this question he desired to say that they were in no sense hostile to measures of river purification, provided these measures were framed with due regard to the necessities of industry and carried out by responsible and competent authorities. In the case of the Alkali Acts, with which he (Sir Henry) had had to do, both the public and the alkali manufacturers had greatly benefited, and there was no reason why this should not also be the case with water as well as with air pollution. Referring to a few clauses which he

* See this Journal, iii. 581; iv. 2, 94, 98, 157, 165.

thought most dangerous, he pointed out, in the first place, that in Clause 2 a single sample of water collected at one moment from a river might be taken to prove an offence against the Act. This was, however, obviously unfair, as an average of the twenty-four hours was absolutely necessary in order to obtain any knowledge of the condition of the river. Again, in Clause 3, the judge was made responsible for a given method of purification, whereas he ought only to be responsible for results, and should have nothing to do with how that result was arrived at. Clause 6, again, opened the door to malicious or factious legislation, as it actually permitted any individual, without incurring any expense, to bring actions through the County Court against any persons supposed to infringe the standards, and to lay all charges on the defendant. To show the House that the standards proposed were either too stringent or too lax, he stated that the rain-water in Manchester contained on an average more than double the amount of acid which was placed as a limit in the case of water used for potable purposes. So that an action would lie against the heavens, though whether penalties could be exacted was doubtful. Again, a water containing one part of sulphur in 100,000 parts of water was allowed to pass into potable streams, and yet this water had a strong smell of sulphuretted hydrogen. In conclusion, he insisted on the advisability of rejecting this bill, both in the interests of sanitary science and of industry. A simple bill might be drafted which would deal satisfactorily with the great

evil of sewage contamination, no untreated sewage being permitted to pass into any water-course, and when that had been done the much more difficult and complicated, though far less important matter—from a sanitary point of view—of manufacturing pollution might be proceeded with.

Mr. J. F. HUTTON, in seconding the motion for the rejection of the bill, said the promoters of the bill could not have any idea of the injury it would do to the great manufacturing industries in the North of England.

Mr. CHAMBERLAIN said the bill would seriously interfere with, if not entirely destroy, some of the most important industries in the North of England. A reference to a single clause of the bill would show the House that they ought not to accept it. The 6th Clause proposed that if the Sanitary Authority refused to prosecute, then any person who felt aggrieved would have a right to proceed himself, and charge all the expenses upon the Sanitary Authority. That was to say, that any person alleging a grievance was entitled to call upon the ratepayers to prosecute his case at their expense. If an improvement in the existing law was demanded it must be looked for in a better system of local government. He should therefore support the motion for the rejection of the bill.

Lord C. BERESFORD, as one of the members who introduced the bill, was willing to refer it to a Select Committee.

The motion for the rejection of the bill was carried.

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Improvements in Apparatus for Grinding or Reducing Quartz, and other Hard or Brittle Substances. R. Morris, Doncaster, and J. Wood, West Stockwith. Eng. Pat. 1955, February 12, 1885. 8d.

THE inventors mount a ring of hard metal in a vertical position upon anti-friction rollers between two side frames. Inside the ring they mount a heavy roller bearing upon the inner circumference of the said ring, and supported in bearings in the side frames, provided with springs and set screws for adjustment. Rotary motion is given to the ring in any convenient manner, and the material to be ground is fed between the roller and the ring, whilst a scraper may be added for diverting the ground material.—B.

Improvements in Freezing or Refrigerating Liquids, and in Means and Apparatus to be used therefor. J. Csete, Aston. Eng. Pat. 3317, March 14, 1885. 11d.

THE inventor produces freezing by means of evaporation in vacuo, aided by the use of acid. A jacketed freezing chamber contains the moulds with the liquid to be frozen, a small quantity of strong brine occupying the space below the moulds. Underneath the freezing chambers is placed a closed vessel containing acid, which is slightly agitated by means of a revolving screw. An air-pump is connected with both the freezing and acid chambers in such a way as to enable a partial vacuum to be produced in either or both, as may be required, for the

purpose of allowing the vapour from the freezing chamber either to reach the pump direct or to do so only after its passage over the acid. In case of the apparatus being required for the cooling or refrigerating of liquids instead of for the production of ice, the moulds are replaced by a circulating coil.—B.

Improvements relating to the Manufacture of Ice and Apparatus therefor. H. H. Lake, London. From Wm. Raydt, Hanover. Eng. Pat. 3347, March 14, 1885. 8d.

THE inventor uses a water jet apparatus (water air pump) for creating the necessary vacuum, with the view to produce transparent ice. For that purpose the jet apparatus is connected by tubes with the condensers to participate in the vacuum, whilst the cooling water employed in the operations of the ice machine is used for forming the jet, thus utilising the water.—B.

Improvements in Apparatus for Purifying Water for Steam Boilers. J. A. Bowers, Acton. Eng. Pat. 12,810, October 26, 1885. 8d.

THE apparatus consists of a V-shaped skimming plate placed at the level of the surface of the water in the boiler; a pipe from this leads to a vessel outside the boiler, delivering the water at the periphery and causing the circulation to be effected, to the central portion of the vessel through a voluted passage formed by a coiled sheet; by convection the water returns by a pipe leading from the centre of the separator beneath the surface of the water in the boiler. The scum collected may be discharged through a cock.—C. C. H.

Improvements in Storing the Force of Wind, Water, Steam or Electricity by the Regeneration of Spent Lyes used in Fireless Steam Generators. A. M. Clark. From M. Honigmann, Grevenberg. Eng. Pat. 4776, April 17, 1885. 8d.

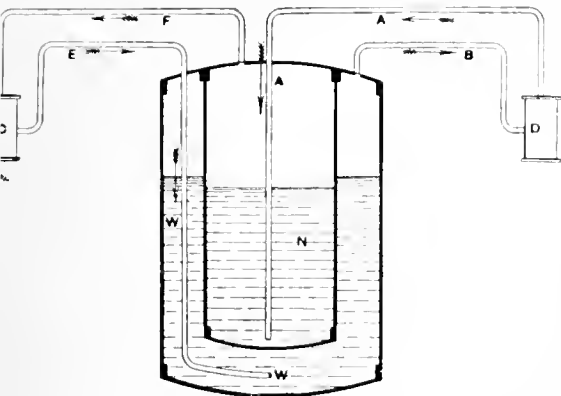
THE invention relates to a process for the transformation of the power of wind, water, steam, or electricity into stored or accumulated steam power, by the use of soda, or other substances whose solutions have a high boiling

* Any of these specifications may be obtained by post, by remitting the cost price, plus postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8d.	4d.
Above 8d., and not exceeding 1s. 6d.	1d.
" 1s. 6d., " " 2s. 4d.	1d.
" 2s. 4d., " " 3s. 4d.	2d.

point. The illustration will give an idea of the course of operations as described by the inventor.

In the closed double boiler the inner vessel contains the soda solution, the outer hot water. When the soda solution N has been diluted by the exhaust steam received through the pipe A from the steam engine D, the heat carried into the solution by the steam has produced fresh steam from the water W, thereby providing a supply to the engine D through the pipe B. The compressor C is



then set to work by means of wind, water, or other extraneous power, withdrawing the aqueous vapour from the soda N by means of the pipe F, and forcing it through the pipe E into the water W which, becoming heated, communicates its heat to the soda N, thereby increasing the evaporation of the solution. This continues until the soda is sufficiently concentrated, when the apparatus can again evolve power.—B.

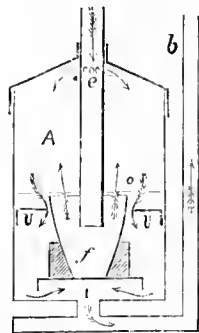
Improvements in Stop Valves for use with Chemical Fluids W. T. Cortin, Newcastle-on-Tyne. Eng. Pat. 14,494, November 26, 1885. 6d.

THE patent refers to the application of lead regulus, or other suitable material not affected by the chemical fluid, for constructing the body and the interior portions of screw-down valves whilst using brass or other metal for the outer portions, such as the screwed part of the spindle. The inner and outer portions of the latter are joined in a way to prevent the turning of the valve whilst being raised or lowered.—B.

II.—FUEL, GAS, AND LIGHT.

Determinations of Heat of Combustion. F. Fischer. Dingl. Polyt. J. 885, 258, 330.

IN the apparatus constructed by the author, the products of combustion are carried off from below. In order that the combustion of coal may be as complete as possible,



the inlet pipe for oxygen is lengthened by the addition of a thin platinum tube s, which is provided with small openings e above. To prevent too rapid cooling of the

crucible, the platinum vessel f is surrounded below by a layer of asbestos, platinum wire gauze being placed as a cover on the crucible. The gases formed during combustion rise through the gauze, heat the oxygen in the tube s, mix with the oxygen passing through e, and by means of the annular ring r are forced to pass through a, extending beyond the sides of the crucible. The temperature of the gases passing away through b is scarcely 1° above that of the water. In the combustion of charcoal, turf, etc., no residue remains in the crucible. In the case of coal, the lower portion of the crucible is covered with a sheet of asbestos, which together with the residue is placed in a combustion tube, and the combustion completed in oxygen. A portion of the water present condenses in the condenser, whereas another portion escapes as vapour. The calculation must therefore take into account the quantity of liquid or steam formed, and for every 1grm. water 610cals. added or subtracted, an operation which has apparently been previously neglected. With one trial 874mg. charcoal were used. The experiment gave CO₂ 2490mg., CO 32mg., C in residue 16mg., total of carbon 709mg. H₂O in vapour 104mg., liquid 126, hydrogen in the gases 2mg., in the residue 5mg., total 26.2mg., ash 63mg. The determination by the calorimeter and by elementary analysis were as follows:—

	Calorimeter.	Analysis.
C	81.12	80.91
H	3	3.11
N .. .. .	— .. .. .	.91
S .. .. .	— .. .. .	.51
O	—	7.14
Ash	7.21	7.42

The water value of the calorimeter amounted to 1624cals., temperature of air 14.9°, initial temperature in calorimeter 12.81°, final temperature 16.86°. The following is the heat of combustion calculated from the above data:—

By the calorimeter	105 × 1621	= 6577cals.
For CO	32 × 2.4 = 77	
For C	16 × 8.1 = 130	
For H	0.7 × 28.8 = 20	
The higher specific heats of products =	20	
	6821	
Less condensed water	126 × 610 = 77	
	6747	

Calculated for 1grm. 6747 : 874 = 7720cals. Compared with vapour at 20°, the formula of Dulong gives 7175.—J. B. C.

New Method of Estimating the Heat of Combustion of Coal and Organic Compounds. Berthelot and Vieille. Ann. Chem. Phys. 6, 546.

THE authors propose burning the substance in pure oxygen compressed under seven atmospheres. The combustion is effected in a shell of special construction placed in the calorimeter. For determinations of the heat of combustion of coal, cotton, or analogous substances, the ignition is effected by means of a metallic thread heated to redness by an electric current. The combustion is complete in a few seconds. If the substance to be burned is a liquid, it is mixed with silica or other inert material, and ignited in a similar manner. The shell is so constructed that the calorimeter requires only a small amount of water for filling. A shell holding 200 to 250cc. requires 550cc. of water. The calorimetric determination is made in 3–4 minutes, whilst the usual methods require from 15–20 minutes.—D. B.

Improvements in the Application of Gas Fuel to Boilers for Heating Purposes. John Watson, St. Albans. Eng. Pat. 1400, October 31, 1885. 8d.

THE boiler is enclosed in a casing of suitable metal, and has one flue extending throughout its length. Gas burners on the Bunsen principle are situated within the flue, and also underneath the boiler. This is an improvement upon the invention referred to in Eng. Pat. 156, 1884.—A. R. D.

Improvements in Apparatus for making Oil Gas. T. Alexander, S. Alexander, and R. Paterson, all of Kirkcintilloch, Dumbartonshire. Eng. Pat. 3323, December 2, 1885. 8d.

A CYLINDRICAL horizontal retort is so set in an oven or due space that it can be heated with ordinary fuel by means of a firegrate attached. The oil is led to the back of the retort by a series of horizontal pipes open at their ends. The conversion of the oil is begun during its passage along these pipes, and is completed in the body of the retort, from the back to the front of which the gas has to pass, as the exit is situated in the latter portion. The oil is led into each pipe by a side branch, and the outer end of the said pipe is fitted with a screw plug which can be removed when cleaning is desirable.

—A. R. D.

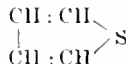
An Improved Method of Regenerating Waste Gases. A. T. D. Berrington, Ebbw Vale. Eng. Pat. 3908, December 2, 1885. 4d.

WASTE gases, such as those from furnaces, are caused to pass through a mass of fuel in process of combustion. The fuel is contained in a suitable chamber, and only just sufficient air is admitted to support its combustion. By this process, the carbon dioxide of the waste gases is reduced to carbon monoxide and rendered available for fuel again. —A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Researches on the Chemical Structure of Thiophen. L. Gattermann, A. Kaiser, and V. Meyer. Ber. 18, 3005.

V. MEYER's constitutional formula for thiophen,



being opposed to numerous observations which appear to throw some probability on the existence of three thiolenes, $\text{C}_4\text{SH}_2\text{CH}_2$, and of three thiophenic acids, $\text{C}_4\text{SH}_2\text{COOH}$, the authors investigated this subject more minutely. They could obtain only two groups of chemically different mono-derivatives of thiophen, so that the original structural formula can be retained. Of the two thiophenic acids differing in chemical constitution, one exists in two forms. It is mostly obtained as the β -acid melting at 126.5° , but when prepared by distillation with potassium cyanide, α -thiophenic acid is formed which melts at 118° . Both modifications yield identical derivatives. Of thiotolens the β and γ -compounds only exist, α -thiotolen of coal-tar being a mixture of the two former. —D. B.

Rapid Process for Removing the Black Acid resulting from the Purification of Mineral Oils. V. Falke. Chem. Zeit. 9, 1869.

To remove the last portions of the waste acid obtained in the purification of mineral oils, water or alkaline liquids are usually employed. Owing to the formation of an emulsion, a large amount of oil is, however, carried away. To overcome this difficulty the author proceeds as follows: Having mixed the oil with concentrated sulphuric acid in the usual manner, the waste acid is drawn off as quickly as possible. The oil is then agitated for 15 minutes with 0.5 per cent. of sulphuric acid of 60°B , the acid drawn off, and the operation repeated with acid of 50°B . By diluting the strength of the waste acid in this manner it is possible to remove the last traces thereof, with water or alkalis, without forming an emulsion. —D. B.

The Thickening of Coal Tar. Kunath. Chem. Zeit. 9, 1893.

THE thickening of tar is not merely due to the presence of particles of coal carried over mechanically with the gas,

but is influenced also by the treatment of the coal in the retort, local superheating of the gas being the principal cause of the thickening. To obtain a thin tar the author recommends the reduction of the gas space in the retort, and the diminution of all contact surfaces by charging the retorts with as much coal as possible. —D. B.

The Cause of the Discolouration of Carbolic Acid. A. Kriemel. Pharm. Post. 1886, 19, 1.

THE author has come to the following conclusion: The red colour of carbolic acid is produced by a large number of metals and metallic oxides, particularly Cu, and then Pb, Ag, Zn, whereas Sn appears to have no action, with or without the presence of ammonia. These metals enter into combination, forming always one and the same organic compound, which dissolves in carbolic acid with a red colour, in concentrated H_2SO_4 with a blue colour. This compound is therefore not rosolic acid, which the sulphuric acid dissolves with a yellow colour. —J. B. C.

A New Method for the Preparation of Hydrogen Gas. F. Hembert and Henry. Compt. Rend. 1885, 101, 797.

THE inventors pass superheated steam in a fine spray over coke heated to redness, whereby a mixture of equal volumes of hydrogen and carbon monoxide is formed. This mixture is led into a second retort also heated to redness, filled with fire-proof materials. The second process has the object of promoting a thorough mixing of the gases. In the second retort also, steam is allowed to enter heated to its point of dissociation. These gases act upon one another, hydrogen is formed and carbonic acid gas. In this way 3200cbm. hydrogen are obtained from 1 ton of coke, and the price of the hydrogen is .015 franc per lbm. —J. B. C.

Treatment of the Waste Acids resulting from the Purification of the Light Oils of Coal Tar for the Utilisation of the said Waste Acids, and of the By-products resulting therefrom. A. A. Vale, London. From the Chemische Fabrik Actien Gesellschaft, Hamburg. Eng. Pat. 9614, August 12, 1885. 6d.

THE sulphuric acid employed for the purification of light oils is recovered by diluting the waste acid with water, to a density of from 1.2 to 1.25. The acid is then drawn off and utilised for the manufacture of ammonium sulphate, or employed for the extraction of the organic bases contained in crude naphthas, before washing with concentrated sulphuric acid. To render the acid perfectly colourless it is again agitated with tar oils, carbolic acid or similar substances. The tarry matters separated from the waste acid are used as impregnating liquids or paints in the form of solutions in tar oil, carbolic acid and the like. —D. B.

IV.—COLOURING MATTERS AND DYES.

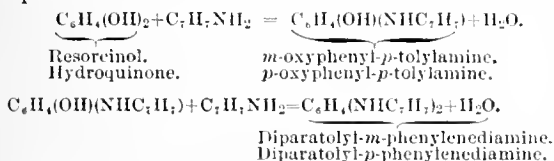
Preparation of Mononitroanisole and Mononitrophenetol by Kolbe's Method. C. Willgerodt and M. Ferko. J. Prakt. Chem. 1886, 152.

ANISOLE and phenetol are prepared according to Kolbe by heating aqueous solutions of potassium methyl- and methylsulphate with sodium phenylate in a retort with reversed condenser or under pressure, and he suggested that nitrophenetol and nitroanisole might be similarly prepared, but Kander obtained very poor results. The authors have succeeded in preparing the nitro bodies by heating alcoholic instead of aqueous solutions of sodium nitrophenylate and the above-mentioned sulphate in sealed tubes to 200° . The ethers were precipitated by water and purified by distillation with steam. The products obtained in this manner were extremely pure, the melting points being quite constant and higher than those previously observed. The melting point of paranitroanisole was found to be 54° instead of 51° , and of paranitrophenetol 60° instead of

57° to 58°. The corresponding ortho compounds were obtained in the form of oils. It was found that paratoluenetol was only partially decomposed by water at 150°.—S. Y.

On the Action of Paratoluidine on Resorcinol and Quinol (Hydroquinone). A. Hatschek and A. Zega. J. Prakt. Chem. 1886, 209.

THE action of paratoluidine on resorcinol and hydroquinone is quite analogous to that of aniline. When either dihydroxybenzene is heated to 260–270° with paratoluidine and calcium chloride, a large yield of meta- or paraoxyphenylparatolylamine is obtained, together with a small quantity of the corresponding ditolylphenylenediamines. The reactions are expressed by the following equations:—



The yield of the metoxyphenylparatolylamine was about 60 per cent., and of the paraoxyphenyl compound about 80 per cent. of the calculated amount. The reaction takes place without calcium chloride by continued heating at 300°.

The diamines are the chief products when a mixture of calcium and zinc chlorides, or zinc chloride alone, is employed. In the latter case the temperature should not exceed 220°, in the former 240°. The yield of the meta-phenylene compound was about 50 per cent., and of the para compound about 80 per cent. of the amount calculated. The two oxyphenyltolylamines have the properties of monobasic phenols and weak monacid bases, the ditolylphenylenediamines only those of weak diacid bases.

Metaxyphenylparatolylamine crystallises in small colourless needles or prisms melting at 91° to 92°, and boiling without decomposition at 350°. It dissolves easily in alcohol, ether, benzene, and acetone.

Diparatolylmetaphenylenediamine forms silky needles, melting at 137°. The compound is decomposed on boiling. It dissolves with difficulty in cold alcohol, benzene, and glacial acetic acid, but readily on warming.

Paraoxyphenylparatolylamine was obtained in the form of white lustrous scales. This body melts at 122°, and boils between 350° and 360°. It is very soluble in cold alcohol and benzene, and in hot glacial acetic acid.

Diparatolylparaphenylenediamine crystallises from benzene or alcohol in colourless silvery scales, which melt at 182°. It dissolves readily in hot alcohol, benzene, and glacial acetic acid, but it is nearly insoluble in the cold liquids. Numerous derivatives of these bodies were prepared, and their melting or boiling points determined.

When paroxyphenylparatolylamine is heated with aniline or orthotoluidine and a mixture of the chlorides of zinc and calcium, the mixed diamines are not formed, but aniline yields diphenylparaphenylenediamine and diparatolylparaphenylenediamine, while from orthotoluidine the latter body and diorthotolylparaphenylenediamine are obtained.—S. Y.

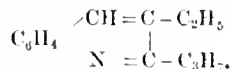
Communications from the Laboratory of the Royal Technical School in Munich. W. v. Miller. Ber. 18, 3360.

THE presumption that the formation of acrolein and methylacrolein precede the formation respectively of quinoline and quinaldine, induced O. Döbner and W. v. Miller to act upon aniline with phenylacrolein, this resulting in the synthesis of α -phenylquinoline. Although in this case a non-saturated aldehyde was employed, the synthesis of quinaldine with ordinary aldehyde, aniline and strong hydrochloric acid, had already shown that the condensation of a saturated aldehyde to the acrolein of a higher carbon group, and the further condensation of this acrolein to a quinaldine derivative, could take place in one stage. Thus by heating

propionaldehyde with aniline and concentrated hydrochloric acid, Kugler obtained ethylmethylquinoline, the formation of which base must be preceded by that of an ethylmethylacrolein. Döbner and W. v. Miller obtained a hexylamylquinoline from α -naphthol, aniline, and hydrochloric acid, and they consider that all aldehydes containing the $\text{CH}_2\text{—CHO}$ group (and therefore capable of forming acroleins) must yield a quinaldine derivative when heated with a primary amine and concentrated hydrochloric acid. To prove this view the investigations, with certain aldehydes which fulfil this condition, have been carried out.—T. L. B.

Condensation of Normal Butaldehyde with Aniline and Hydrochloric Acid. Myrtil Kahn. Ber. 18, 3361–3372.

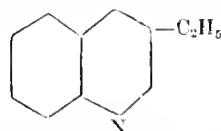
NORMAL butaldehyde (100grms.) was slowly run into a cooled mixture of aniline (60grms.), and concentrated hydrochloric acid (120grms.), and then heated for 5 or 6 hours on the water-bath. The product of the reaction was extracted with ether, and ultimately fractionally distilled, two chief fractions being obtained, one boiling at 230° to 250°, being the hitherto unknown normal butylaniline, the other and larger fraction boiling at 280° to 300°, being the α -propyl- β -ethylquinoline—



The pure base is a colourless oil boiling at 291°, becoming rapidly dark on exposure to air and light, is soluble in the ordinary solvents except water, and easily distilled in a current of steam. It is not attacked by nitrite of sodium. The hydrochloride forms flat triclinic plates, containing 2mols. H_2O ; the nitrate long needles with 1mol. H_2O ; the sulphate crystallises in groups of needles; the picrate forms golden leaflets insoluble in cold water, slightly soluble in alcohol, melting at 163°; the chromate, recrystallised from dilute HCl or HNO_3 , long orange yellow needles, which turn black on exposure to air and light; the platinochloride, insoluble in cold water, soluble in hot water, forms yellow needles; the methiodide crystallises from dilute alcohol in golden needles, containing 1mol. H_2O ; and the double salt of platinum and the methochloride, $(\text{C}_{14}\text{H}_{17}\text{N} \cdot \text{CH}_3\text{Cl})_2\text{PtCl}_4$, was obtained in orange yellow dendritic needles.

The perfectly pure base (10grms.) dissolved in dilute sulphuric acid, and oxidised with chromic acid (35grms.) and dilute sulphuric acid (60grms. acid to 250grms. water), yielded about 3grms. of ethylquinolinecarboxylic acid, crystallising from alcohol in fine needles, soluble in water, sparingly soluble in ether. The acid is soluble in hot benzene; it melts at 148° with evolution of carbonic anhydride. It forms salts with both acids and alkalis. The platinochloride forms fine needles grouped together; the picrate fine yellow needles, only slightly soluble in water and cold alcohol; the silver salt forms a white amorphous precipitate, soluble in hot alcohol, forming a fine jelly on cooling; the copper salt precipitates from alcohol as a bright blue precipitate consisting of minute needles.

By the dry distillation of the above acid, carbonic anhydride is given off, and a colourless and highly refractive liquid distils over, which is β -ethylquinoline—



Ethylquinoline boils at 265° under 718mm. pressure, and is identical with the β -ethylquinoline obtained by Baeyer and Jackson. Its picrate forms beautiful glittering fine needles, m.p. 163°.

Normal butylaniline is best obtained in a pure state by reducing with zinc the nitroso-derivative obtained from the fraction boiling between 230° and 250°. It is a colourless oil, boiling at 235° under a pressure of 1

720mm., has a pleasant odour, and is volatile with steam. Its hydrochloride, nitrate and sulphate crystallise well, and are very soluble in water. Its nitroso-derivative, $C_6H_5N(C_4H_9)NO$, forms a yellow oil, insoluble in water and weak acids, readily soluble in alcohol and ether; it gives Liebermann's reaction beautifully, and becomes greenish black on exposure to the air.

Acetyl-butylaniline is a colourless liquid boiling at 273° to 275° under 715mm. pressure.

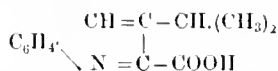
The author caused isobutaldehyde to react on aniline in the presence of fuming hydrochloric acid, obtaining an amorphous, uncrystallisable basic product; but, as was to be expected from Dübner and Miller's theory, no acrolein derivative was formed.—T. L. B.

Action of Isobutaldehyde on Aniline and Fuming Hydrochloric Acid. J. Spady. Ber. 18, 3373—3384.

THE product of the reaction (comp. preceding abstract), after repeated fractional distillation, separates into two main portions; the first, boiling at 240° to 250° , is α -isobutyl- β -isopropylquinoline; the second, boiling at 292° to 296° , is isoamylamine. In order to purify the bases they are converted into their picrates, that of the former being insoluble, that of the latter soluble in cold alcohol.

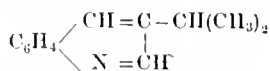
The pure base has a pleasant odour, somewhat similar to that of quinaldine, is an oil boiling at 295° to 296° under 709mm. pressure, is only to a slight degree volatile in a current of steam, is very hygroscopic, but insoluble in water. Its nitrate is formed as an oil, which after a short time solidifies to a white crystalline mass; it crystallises from hot water with 1mol. H_2O ; the acid sulphate, $C_{16}H_{21}N.H_2SO_4$, crystallises in triclinic pyramids massed together; the hydrochloride forms triclinic prismatic leaflets, $C_{16}H_{21}N.HCl.H_2O$; the chromate forms long needles, insoluble in cold water,—it can only be obtained from quite pure base; the methiodide contains 1mol. H_2O , soluble in alcohol and hot water, insoluble in ether,—precipitates in fine needles from alcohol on adding ether.

β -isopropyl- α -quinolinecarboxylic acid—



is obtained by oxidising the above base (10grms.) with an excess of chromic acid (75grms.) dissolved in sulphuric acid (114grms.), and water (228grms.). The yield is about 20 per cent. on the base used. The acid is sparingly soluble in hot water and ether, easily soluble in hot alcohol; it crystallises in prismatic colourless leaflets, fusing at 188° to 189° , with but slight decomposition, and subliming without decomposition. It has but slight acid and basic qualities, rendering its salts easily decomposed with water; the silver double salt precipitates as a flocculent mass of needles, $C_{13}H_{12}NO_3Ag + C_{13}H_{12}NO_3.H$, decomposed by water; the *platinochloride* forms orange crystals when precipitated from hot hydrochloric acid.

When isopropylquinolinecarboxylic acid (1 part) is distilled with slaked lime (4 parts), quinoline C_9H_7N , and diquinoline $C_{18}H_{12}N_2$ are formed; the latter melts at 192° , and appears identical with the diquinoline obtained by Japp and Graham, and also by Weidel; but when the acid is heated by itself, somewhat above its melting point, carbonic anhydride is evolved, and the chief product is β -isopropylquinoline—



a pale yellow liquid, boiling at 275° to 280° under 715mm. pressure, solidifying in a freezing mixture, and commencing to melt above, -10° . It is insoluble in water; characteristic is the hydrochloride, crystallising in fine needles from a little cold dilute hydrochloric acid; the platinochloride forms fine needles; the chromate precipitates as an oil, solidifying after a short time; the picrate forms long delicate needles.

Isoamylaniline, $C_{11}H_{15}N$, is formed in the first-mentioned reaction according to the equations:—

1. $(CH_3)_2CH.CH_2.CHO + H_2 = (CH_3)_2CH.CH_2.CH_2.OH$
2. $C_6H_5NH_2 + HO.CH_2.CH_2.CH(CH_3)_2 = C_6H_5NH - CH_2.CH_2.CH(CH_3)_2 + H_2O$

It forms a colourless oil, boiling at 242° to 244° , is insoluble in water, soluble in alcohol, ether and benzene, and has an agreeable aromatic odour. The picrate precipitates as a red dish-yellow oil from alcohol. The hydrochloride of this base is a very easily soluble salt, whilst the hydrochloride of the amylaniline obtained by A. W. Hofmann from amyl bromide and aniline was fairly insoluble; it is therefore probably an isomer of this base. The nitroso compound is an oil, giving Liebermann's reaction. Acetylamylaniline is a fluid boiling at 278° (Bar. 720mm.), insoluble in water, soluble in alcohol and ether. The oxalate and nitrate are the most insoluble salts of isoamylaniline.—T. L. B.

Lokao or Chinese Green. R. Kayser. Ber. 18, 3417—3429.

THIS colouring matter is obtained in China from different varieties of buckthorn (*Rhamnus*), and is brought into commerce in the form of thin blue slabs, easily broken, but difficult to pulverise. According to Cloez and Guignet (Ber. 5, 338), it is a lake containing the colouring matter lokain $C_{28}H_{34}O_{17}$, and leaving twenty-six per cent. of ash. The authors have repeated these investigations, but find forty-seven per cent. of mineral matter, consisting chiefly of clay and chalk. Lokao was extracted with concentrated ammonium carbonate solution; on the addition of a double volume of alcohol to the filtered extract, a deep blue precipitate of the ammonium salt of lokaonic acid $C_{42}H_{48}O_{27}$ is formed. From the solution of this salt in water oxalic acid precipitates the free lokaonic acid, which, when dried, presents the appearance of a pulverulent bluish-black substance, insoluble in water, alcohol, ether, chloroform and benzene. Friction imparts to it metallic lustre. The monammonium salt forms small crystals, with bronze-like lustre, from which the diammonium salt $C_{42}H_{48}O_{27}(NH_4)_2$ is obtained, by moistening them with ammonia and subsequent drying over sulphuric acid. The barium salt $C_{42}H_{46}BaO_{27}$ is insoluble in water and alcohol. The potassium salt $C_{42}H_{46}K_2O_{27}$ forms a dark blue amorphous precipitate from alcohol. Soluble compounds of lokaonic acid show perfect absorption of the spectrum in the red and yellow portions only. Boiling dilute acids decompose lokaonic acid into a carbohydrate lokaose $C_6H_{12}O_6$, and lokaanic acid $C_{36}H_{36}O_{21}$, which is a bluish-violet crystalline powder insoluble in water, alcohol and ether, containing one mol. of water, which is given off at 120° . The ammonium salt $C_{36}H_{35}O_{21}NH_4$ is a deep blue powder soluble in water, with a violet colour; the barium and lead salts are dark blue powders insoluble in water and alcohol. Soluble compounds of lokaanic acid in very dilute solution show a characteristic perfect absorption in the yellow and yellow-green portions of the spectrum. The filtrate from the lokaanic acid, after removal of the acid and dirt, is evaporated nearly to dryness, then taken up with five times its bulk of hot alcohol, and allowed to slowly evaporate over calcium chloride; small needles of lokaose are thus obtained which are dried over sulphuric acid. Lokaose reduces Fehling's solution with half the power of glucose, from which it also differs by its optical inactivity. The decomposition of the lokaonic acid is expressed by the equation $C_{42}H_{48}O_{27} = C_6H_{12}O_6 + C_{36}H_{36}O_{21}$. Reducing agents convert blue solutions of lokaonic and lokaanic acids into blood-red solutions, which become green on exposure to the air.

Lokaanic acid is decomposed by cold concentrated sulphuric acid according to the equation $C_{36}H_{36}O_{21} - 5H_2O = C_{36}H_{26}O_{16}$. This latter substance forms a red-brown powder; its barium compound $C_{36}H_{24}BaO_{16}$ is also a red-brown substance. Concentrated potash solution (fifty per cent.) decomposes lokaanic acid into a brown powder and phloroglucinol; the former body the authors term delokaonic acid $C_{15}H_9O_8$; the following

equation representing the reaction : $C_{35}H_{36}O_{21} = 2C_{15}H_9O_6 + C_5H_6O_3 + 6H_2O$.

Nitric acid (sp. gr. 1.15 = 50 parts) was heated with iokanic acid (ten parts) and water (300 parts), producing nitrophloroglucinol $C_6H_3(NO_2)_3O_3$, and a brown powder which was not examined; oxalic acid could not be found.

—T. L. B.

Manufacture of Magenta. P. Schoop. Dingl. Polyt. J. 1885, 258, 276.

THE author describes the manufacture of magenta by the arsenic acid process. The melting vessel of cast-iron (Fig. 1), and its arrangement may be readily understood from the diagram. The charge is 700kilos. arsenic acid 75° B., 300kilos. recovered arsenic acid 75° B., 300kilos. aniline for red, and 200kilos. "échappé" from a previous operation.

The fire is regulated so that distillation begins after about 7 hours. After 400 litres have passed over, the melt has already become thick, and the fire is then lowered. The contents are now run out, and the cooled melt broken up. Its weight amounts to 886kilos. The distillate is run into a separating vessel, and 100kilos. of salt added, whereupon the oil quickly separates. The distillate may

the agitator R passes through the cover D. The cylindrical portion of the apparatus, which rests upon the lower vessel, is made of boiler plate, and is shut off from the latter by a slightly curved cover. At about three-quarters of the height of the whole apparatus, a small let-off pipe is fixed, and up to this point the boiler is filled with water. For a continuous process at least two such extraction boilers are necessary. About a tenth portion of the crude melt is treated with about 3600 litres of water, and heated with steam, so that the pressure amounts to 1.5 to 2 atmospheres. After four hours the mass is forced through a filter-press, and the residue treated in the same way in a second boiler. This second extract is then employed for exhausting a fresh portion in the first boiler. The residue twice treated forms one part of the useless arsenical residue. The solution of the dye, after standing for half-an-hour to allow impurities to settle, is stirred up whilst hot with 200kilos. of common salt whereby, on cooling, the hydrochloride of the colour separates almost completely. The mother-liquors, after standing 2 days, are treated from time to time with milk of lime, in order to separate a further quantity of colouring matter, which is treated apart. The residual liquid, which contains arsenic, is precipitated with lime.

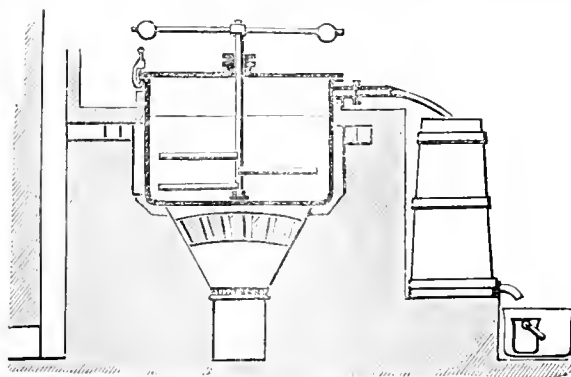


FIG. 1.

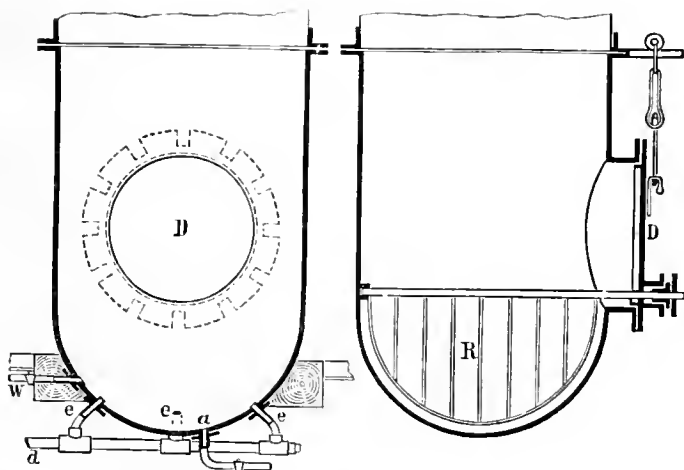


FIG. 2.

FIG. 3.

be used more profitably for making safranin. The melt is ground with water to a fine mud, which is forced through a filter-press. The filtrate is evaporated for recovering the arsenic acid, and the solid portion in the press, again treated with warm water and filtered. The filtrate from this is employed for the next melt. The crude melt is extracted twice in a boiler with boiling water; the apparatus (Figs. 2 and 3) consists of a cast-iron vessel, which may be closed by a cover D, running upon rails; three steam inlets e (37mm. diam.), w the water pipe (37mm.), and a the outlet pipe. The axis of

Crude magenta, salted out as above-described, is purified by systematic fractional precipitation. The crude magenta obtained from one-fifth of the melt is dissolved in a wooden vessel with 1000 litres of water heated by steam; to which 40 litres of 4 per cent. soda solution are slowly added. The liquid is passed through a coarse filter into another wooden vessel, and HCl is added, to prevent the separation of chrysianiline, and to retard the crystallisation of the magenta. In about two days crystallisation is complete. The mother-liquor is run off, and the crystals are dried in the air, and afterwards in a

drying room at 40°. The colouring matter is precipitated from the mother-liquors with caustic soda, and about 40 kilos. of this dissolved in HCl and recrystallised. From these mother-liquors "cerise," an inferior magenta, chrysaniline and "cinnamon brown" may be obtained. Mauvaniline, an almost valueless product, is also separated. After filtration of the "cerise" from its mother-liquors, the colour is washed, neutralised with hydrochloric acid, and evaporated with steam in iron pans. In this way the cerise of commerce is obtained. In the filtrate the remaining magenta is precipitated with soda. The resins may be purified according to the wants of the market, to obtain by-products such as "grenadin" and "maroon." In order to test magenta for chrysaniline, HCl is added to the hot aqueous solution, and then zinc dust in small quantities until the red colour has disappeared. If the magenta were free from chrysaniline, a limpid liquid is obtained; in the other case it has a yellow colour.—J. B. C.

Isomeric α -Naphthylaminesulphonic Acids. Otto N. Witt. Ber. 19, 55–59.

RELIABLE data have long been wanted for these technically very important bodies; the author has therefore commenced a number of experiments with a view to obtaining them. The naphthionic acid of Piria obtained by acting on nitronaphthalene with ammonium sulphite; the acid of Neville and Winther, obtained by heating equal molecules of naphthylamine and sulphuric acid at 200°; and the acid obtained by heating one part of naphthylamine with five parts of concentrated sulphuric acid till entire solubility in alkalis is attained, were prepared and found to be identical. It is proposed to maintain the name naphthionic acid for this sulphonic acid. The free acid crystallises with one-half mol. H_2O , and is soluble in about 4500 parts of water at 15°. The calcium salt forms pale pink tables with eight mol. H_2O ; the sodium salt crystallises in large monosymmetric tables with four mol. H_2O . But if a concentrated solution of these salts be quickly cooled, thin glittering plates are obtained, which, however, soon disappear, and give place to the other form. A dilute solution of the sodium salt $C_{10}H_6(NH_2)SO_3Na$ shows a very strong bluish-violet fluorescence.—T. L. B.

Manufacture of Blue and Violet Colouring Matters by Oxidation of Thio-bases of Diamines. John Imray, Chancery Lane, Middlesex. From J. Boas-Boasson, of Lyons. Eng. Pat. 3889, March 26, 1885. 6d.

ACCORDING to this invention, the required diamine is produced by the reduction of the amidoazo-compound, by means of sulphuretted hydrogen. The amidoazobenzene is heated in aniline solution to 45° C., and SH_2 passed through the solution till complete reduction is effected according to the equation $C_6H_5.N=N.C_6H_4.NH_2 + 2H_2S = C_6H_5.NH_2 + C_6H_4(NH_2)_2 + 2S$. The aniline is removed by steam distillation, the sulphur filtered off, and the solution of paraphenylene diamine evaporated to the crystallising point, and the crystals purified by distillation. The paraphenylene diamine is heated in a closed vessel, for about four hours, with sulphur, to 170–180° C., and is thus transformed into the thio-base, which is dissolved in dilute hydrochloric acid, filtered, allowed to cool, and then oxidised with ferric chloride, potassium dichromate, or other suitable oxidising material. The blue colouring matter is salted out, filtered, pressed and purified by another solution, and salting out. The homologues of amidoazobenzene may be employed in this process, the colour becoming more violet in shade the greater the molecular weight of the diamine.—R. M.

Improvements in and relating to Colouring Matters. Henry Harris Lake, Chancery Lane, Middlesex. From The Schoellkopf Aniline and Chemical Company, New York, U.S.A. Eng. Pat. 15,775, December 22, 1885. 6d.

THE first part of this specification relates to the preparation of what is claimed as a new naphthol-disulphonic

acid. 100 parts of α -naphthalene monosulphonic acid are mixed with 200 parts of sulphuric acid of 66° B., and 45 parts of nitric acid of 40° B. added to the mixture. Two naphthalene-mononitrosulphonic acids are formed, which are converted by reduction into the corresponding amido-sulphonic acids. The latter are said to be new modifications, and are separated from each other by the different solubility of their sodium salts in water. The acid giving the more insoluble sodium salt is diazotised in the usual way, and the diazo-sulphate boiled with dilute sulphuric acid, by which operation it is converted into a new naphthol-monosulphonic acid, which, on being heated to 80–90° C. with twice its weight of sulphuric acid of 66° B., gives the new disulphonic acid. The latter is said to be an α -acid, and to differ from all hitherto known naphthol-disulphonic acids, this difference being especially shown in its power of forming a nitro-compound when treated with nitric acid, the resulting naphthol-mononitro-monosulphonic acid being a yellow dye-stuff differing from the well-known acid naphthol yellow (α -naphthol-dinitrosulphonic acid). The new acid yellow is formed by the action of 54% nitric acid, at 60–70°, for 24 hours, upon the sodium salt of the disulphonic acid, dissolved in twice its weight of water. The azo-dyes are obtained from the new disulphonic acid by the usual methods, diazoxylene chloride giving a scarlet, diazobenzene and diazotoluene chlorides giving oranges. Diazoazobenzene chloride gives an "intensely red scarlet," diazoazotoluene chloride a "deep red scarlet," and diazonaphthalene chloride a Bordeaux red. The details of manufacturing these azo-colours are given in the specification.—R. M.

Improvements in and relating to Colouring Matters.

H. H. Lake, Chancery Lane, Middlesex. From the Schoellkopf Aniline and Chemical Company, Buffalo, New York, U.S.A. Eng. Pat. 15,781, December 22, 1885. 4d.

THE object of this invention is the production of a new naphthol-monosulphonic acid, and the azo-colours derived therefrom. In order to manufacture the acid, 100 parts of α -naphthalene monosulphonic acid are mixed with 200 parts of sulphuric acid of 66° B., and 45 parts of nitric acid of 40° B. added to the mixture, so as to produce two naphthalene-mononitrosulphonic acids. The nitro-sulphonic acids are reduced, and the sodium salts of the amido-acids separated, as in the last specification. The acid corresponding to the more soluble sodium salt is converted into the new naphthol-sulphonic acid, by the usual series of diazo-reactions. The new acid is said to differ from all the naphthol-monosulphonic acids at present known, by its giving much redder shades of colour when acted upon by diazobenzene and its homologues. The colours obtained by the action of diazobenzene chloride, diazotoluene-sulphonic acid, diazo α - and β -naphthalene sulphonic acids, etc., upon the new naphthol-sulphonic acid, are described in the specification.—R. M.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

A Process for Treating Vegetable Spinning Fibres. Martin Egmont Colm. Eng. Pat. 15,391, December 15, 1885. 4d.

THIS method consists in treating fibres such as hemp, flax, etc., with a weak acid or alkaline solution, containing pepsin, for about 24 hours.—E. J. B.

Improvements in the Method or Process of Treating Textile Fabrics to render them Waterproof. Thomas Ferncey Wiley. Eng. Pat. 15,906, December 28, 1885. 4d.

THIS invention relates to a method of waterproofing by the employment of two well-known processes. The material is first soaked in a solution of soap, the excess being removed by a pair of squeezing rollers, and then it is treated with a solution of alum. It is then dried and washed, to remove excess of alum, and again dried. The

second process consists in coating the material with a solution of indiarubber and paraffin in petroleum spirit. This is best applied by means of a spray apparatus, patented by Wiley and Hallet, 5512, May 5, 1885.

—E. J. B.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Potassium Antimony Oxalate as a Mordant. E. Kopp. *Monit. Prod. Chim.* 15, 353.

THE author has made experimental trials on the large scale with antimony oxalate and tartar emetic. The former contains 20.341 per cent. of antimony. With baths containing 5grms. of salt per litre of Seine water, no precipitate appeared in the tartar emetic bath, whilst the solution of 50grms. of oxalate in 18 litres of water produced a precipitate of 13grms. 1grm. of this precipitate contained antimony oxide (basic antimony oxalate), 0.519grm.; oxalic acid, 0.086grm.; lime, 0.109 per cent. Methylene blue was precipitated, by a passage of the material through the oxalate bath, redder and less fiery than by a passage through tartar emetic. By using baths with only 1grm. of salt, the author observed that the oxalate bath became much sooner dirty than the tartar emetic bath. Moreover the latter, after the passage of a certain number of pieces was more acid than the oxalate bath, from which it could be concluded that with the oxalate the decomposition is not so complete as with the tartar emetic. A bath of tartar emetic with 1grm. per litre gave the following results:—

Before passage	0.02184grm.	free tartaric acid.
After „ of 30 pieces	0.06370 „	„ „
„ „ 60 „	0.05450 „	„ „

For the oxalate under exactly the same conditions, the following numbers were found respectively: 0.00126grm., 0.01638grm., and 0.02893grm. of free oxalic acid. The trials on the large scale show that the antimony oxalate is of less value than the tartar emetic, not only on account of the formation of insoluble basic salts, but also on account of its relatively higher price. (*This Journal*, iv. 207, 400, 493, 643.)—W. S.

The Use of Carbonate of Ammonia for Alumina Mordants on Cotton. J. Wolf. *Chem. Zeit.* 10, 18.

THE action of carbonate of ammonia in precipitating alumina on cloth has been carefully studied by the author, who found that with normal acetate of alumina, approximately the same results with baths of different concentrations were obtained. A sulphate acetate, $\text{Al}_2(\text{C}_2\text{H}_3\text{O}_2)_4(\text{SO}_4)$, gives with increasing concentration better results, an excess of precipitant not injuring the effect. The sulphocyanide mordants in dilute solutions gave good results. The employment of this method commercially is at present prevented by the high price of the material.—J. B. C.

On the Use of Antimony Hydrate for the Fixation of Aniline Colours. A. Kertész. *Chem. Zeit.* 10, 19.

ABOUT a year ago the author published (*Chem. Zeit.* 9, 306, 1447) a paper in which he maintained that freshly precipitated basic antimony salts—i.e., the hydrated oxide of antimony—will fix tannin in exactly the same way as tartar emetic. This Weber confirmed, but it has lately been flatly contradicted by Lauber and L. Schweickert (*Chem. Zeit.* 9, 1710). The author now repeats his statements, proves them by experiments, and also shows that the paper of Lauber and Schweickert is, to some extent, a confirmation of them, as his experiments show that the addition of chalk to the antimony oxalate solution, which Lauber recommends, precipitates on the average 80 per cent. of the Sb as hydrate; and as Lauber gets very good results with this solution, it is evident that this hydrate must have a powerful fixing action. For dyed goods, therefore, he maintains that his process must always give excellent results, though he is

not so confident of its practicability for steamed goods, on account of the difficulty of exactly neutralising antimony chloride solution with soda, and the danger to steam colours of an excess of soda. It is essential, moreover, that the hydrate should be freshly precipitated, for the tannin takes it up more quickly in this condition. If the hydrate be some days old, the fixation of the tannin is effected, only more slowly.—J. B. C.

Antimony Oxalate as a Mordant. Lauber and Schweickert. *Chem. Zeit.* 9, 1869.

IN the *Chem. Zeit.* 9, 1787, Boetsch points out that the objection to the addition of chalk to the antimony oxalate bath used for the fixation of steam colours, is the partial precipitation of the antimony. The authors in reply state that in their original paper (*Chem. Zeit.* 9, 1710) it was shown that, although a large amount of antimony is precipitated, about 50 per cent. remains in solution. This applies, not merely to the use of antimony oxalate baths, but also to tartar emetic.—D. B.

The Solubility of Antimony Oxide in an Alkaline Solution of Glycerine—A New Mordant for Cotton. H. Köhler. *Dingl. Polyt. J.* 1885, 258, 520.

AN alkaline solution of glycerine dissolves a considerable quantity of oxide of antimony. A mixture of 120grms. caustic soda, 120grms. water, and 100grms. glycerine dissolves 119.2grms. of Sb_2O_3 . One hour's boiling suffices to dissolve the largest possible quantity of oxide. Potash is very much less adapted for the preparation of the above solution. Ammonia does not dissolve the oxide at all. These solutions are strongly alkaline, and can only be neutralised to a given point. On adding a certain amount of acid the oxide is precipitated, but the latter is redissolved by a further addition of acid. The above solution of soda and antimony in glycerine may be used as a mordant for cotton and for half-woollen cloth, in which the wool has been previously dyed. The solution must, however, be entirely free from sulphide of antimony; otherwise the colours lose their brilliancy. The presence of sulphide of antimony may be detected by saturating a sample with HCl until a clear solution is formed. In presence of the sulphide the liquid is coloured yellow, the sulphide forming a flocculent mass on the surface. In this case, the solution may be purified by boiling 100cc. and adding, drop by drop, copper sulphate solution, until no more sulphide can be detected by the above test. The whole solution is then treated similarly with the calculated quantity of CuSO_4 .

Compared with tartar emetic, this preparation is equally efficacious and much less expensive. It is prepared by the firm of Dittler & Co., Höchst-a-M.

—J. B. C.

Improvements in the Manufacture of Washing and Cleansing Fluid. E. Green, Halifax; and E. Needham, Oveden. *Eng. Pat.* 2990, March 7, 1885. 4d.

PEARL-ASH, 7.5 parts, are dissolved in 47.5 parts of ho water; 22.5 parts of turpentine, and 22.5 of ammonia are then added, and the whole well stirred.—C. C. H.

VII.—ACIDS, ALKALIS, AND SALTS.

Improvements in Apparatus and Means or Method for the Decarbonation of Carbonate of Barium and Carbonate of Strontium. W. L. Wise, London. From R. Radot, Paris. *Eng. Pat.* 1982, February 12, 1885, 8d.

A CURRENT of superheated steam is passed over the carbonates heated to redness, when the decarbonation takes place at a comparatively low temperature. For this purpose a retort of refractory material, containing the carbonate, is set above a crucible, and strongly heated by a very direct source of heat. The waste heat is conveyed, by two passages to a regenerator; one of these passages serving to heat the walls of the upper part of the regenerator, while the other heats the crucible.

As the flames issue from the upper part of the regenerator, they heat by transmission its lower chamber, the remaining heat being employed to produce steam in a boiler. The steam travels through the regenerator, where it becomes strongly heated, and is then conducted by heated passages into the crucible, rising hence into the retort.

—S. II.

Improvements in the Manufacture of Carbonate of Soda by Aid of Ammonia. J. T. Schloesing, Paris. Eng. Pat. 4025, March 30, 1885. 8d.

THE object of this invention is the production of sodium carbonate of a much denser character than that usually obtained by the ammonia soda process. A magma consisting of mother-liquor of a preceding operation and ammonium bicarbonate, is run into a vat or cistern provided with a convenient method for filtering, such for example, as a grating placed across the lower part and covered with cloth. There is also an outlet at the bottom for any liquor which is made to trickle through the mass of salts. Whilst filling, the mother-liquor is run out by the hole at the bottom. A solution of brine is then spread over the mass, when the transformation of ammonium bicarbonate into sodium bicarbonate takes place,

There is also at one side of the bottom a hole D communicating with a box E, and at the bottom of the vat a grating covered with cloth serving as a filter. The vat is closed with a movable cover having a central hole, which is in communication with the box G, and which distributes the charge into the different tubs. Great care is necessary to ensure a regular deposition of the charges in the vats. A vat having been filled to a convenient depth with ammonium bicarbonate crystals, the cover is removed, and in its place is put an apparatus by means of which the liquids for the treatment of the ammonium bicarbonate can be applied with great uniformity. This is a circular tray, with a bottom cut in spiral form (Fig. 3). The tray is supported by rollers, and is provided with a central boss through which passes a shaft, resting on the top of the central wooden tubular pillar C, and, continuing upwards, bears a sheave. On the shaft beneath the sheave is placed a sleeve carrying at its upper end a second sheave, and beneath that a cup having a sufficient number of pipes (4 to 8) issuing from the bottom of it, and extending to the outer rim of the spiral-shaped tray. Brine is admitted into the cup, and thence through the pipes to the margin of the tray. The pipes and tray turn in opposite directions. Owing to the inclination of

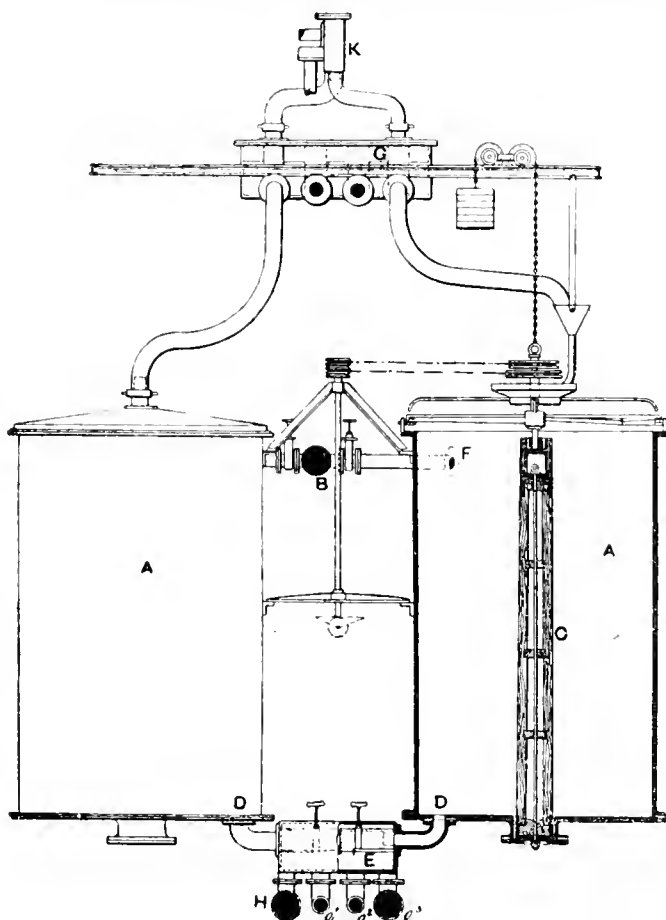


FIG. 1.

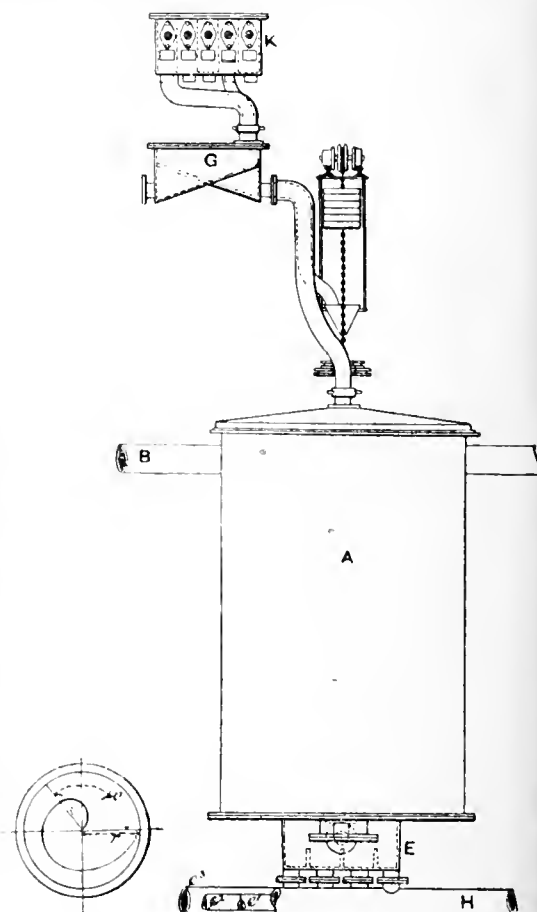


FIG. 2.

FIG. 3.

and a solution of ammonium chloride is formed, which is run out at the bottom. When the operation is complete, the mass, now consisting of sodium bicarbonate, is washed with water, and then furnaceed for the production of sodium carbonate. The process is carried out in an apparatus represented in the annexed drawings. AA are the vats, the number of which may be varied. They are connected in pairs by opening valves B. At the bottom of each vat there is a central orifice into which a plug connected with a wooden tubular pillar is inserted.

the tray, the brine flows inwards until it reaches the spiral edge, from which it falls in drops over the surface of the crystals with the greatest uniformity. When the decomposition approaches completion, the liquor running off at the bottom is diverted into another receptacle, and used at the beginning of the succeeding operation. The mass is washed with water by the same apparatus. After draining, the central tubular pillar C is removed, and the contents of the vat emptied through the opening thus formed. It will then be found that the mass is suffi-

ciently coherent to be removed in fragments to the calcining furnace.—S. H.

Improvements in Apparatus for the Distillation of Ammonia from Ammoniacal Liquors, and for the Treatment of the Resulting Ammoniacal Vapours. From the Berlin Anhaltische Maschinenbau-Actien Gesellschaft. H. Simon, Manchester. Eng. Pat. 2578, February 25, 1885. 11d.

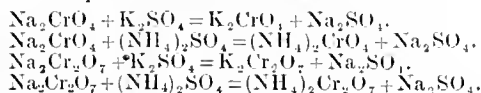
THIS invention relates to apparatus for distilling and concentrating ammoniacal liquors in a continuous manner, wherein such liquors are caused to pass downwards through a column, where, as they flow successively from one tray to the next below, they are brought into intimate contact with steam passing in a contrary direction. The latter liberates the ammonia from those salts in the liquor which volatilise on boiling. The liquor then being made to flow into a chamber containing milk of lime, that part of the ammonia is dissociated which is combined with the fixed salts in the liquor. The apparatus in which this principle is carried out in practice is described in great detail in the specification, and accompanied with nine diagrams.—S. H.

Improvements in the Treatment of Alkali Waste by other Materials in order to obtain Useful Products. F. S. Newhall, Washington, Durham. Eng. Pat. 3933, March 27, 1885. 6d.

A MIXTURE of fresh alkali waste and water is treated with sulphuretted hydrogen in order to obtain a solution of calcium hydrosulphide. This solution is acted upon by a solution of the double chloride of magnesium and calcium, when sulphuretted hydrogen is given off, and may be converted into sulphur or sulphuric acid. The residual solution consists of calcium chloride, holding in suspension magnesia, which is separated, and either used for lining furnaces or converted into magnesium carbonate.—S. H.

Improvements in the Manufacture of Chromates and Bichromates. W. J. Crystal, Glasgow. Eng. Pat. 4290, April 7, 1885. 6d.

THE object of this invention is the manufacture of potassium and ammonium chromates and bichromates from sodium chromate or bichromate, by the addition of potassium or ammonium sulphate. The following equations represent the different reactions:—



The sodium sulphate is then separated from the chromate solution, either by concentrating and salting, or by crystallisation.—S. H.

Process and Apparatus for the Manufacture of Sulphuret of Carbon (Bisulphide of Carbon) and Alkaline Chlorides and Silicates. J. Baptiste-Regi and C. Folie-Desjardins, Toulouse. Eng. Pat. 14,780, December 2, 1885. 8d.

ALKALINE sulphates are heated to redness in a cast-iron retort, and then treated with hydrochloric acid. Sulphurous vapours are given off, which are passed through ignited carbon, and combining with the latter, form carbon bisulphide, which is condensed in a refrigerator. Or a mixture of alkaline sulphates with silica is strongly heated, and the gas given off made to combine with carbon. The residue in the retorts consists of the chlorides or silicates respectively.—S. H.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

On the Influence of the Composition of the Glass upon the Constancy of the Readings of Thermometers. H. F. Wiebe. Math. n. naturw. Mittheil. a. d. Sitzungsber d. Kgl. preuss. Akad. a. Wissensch. zu Berlin, 1885, 629.

THE author, in conjunction with Prof. Abbe and Dr. Schott, endeavoured to obtain a standard glass to be used in making thermometers, by means of which the boiling and

freezing point should show the least possible variation with constant use. The best results were given by the use of a glass of the composition marked I., which he calls Jena glass, which is very easily worked, and but very slightly affected by use. Those marked II. and III. give as constant results, but are somewhat less easily worked.

	I.	II.	III.
SiO ₂	67.5	69	52
Na.....	11	14	—
ZnO.....	7	7	30
CuO.....	7	1	—
Al ₂ O ₃	2.5	—	—
B ₂ O ₃	2	2	9
K.....	—	—	9
	100.0	100.0	100.0

—J. H. H.

X.—METALLURGY, Etc.

The Value of Charcoal and Coke in Blast Furnace Practice. E. Belani. Stahl und Eisen, 5, 603.

THE heating power of fuel per unit of time depends on the amount of surface presented to the draught and the combustibility of the fuel. The author obtained as mean value for the combustibility of charcoal the number 1.5 and for coke 1. The surface number for charcoal was 5.5, and for coke 1. By assuming that the product of combustibility and surface represents the heating power in a unit of time, the following values are obtained:—Coke=1; charcoal=8.25. In order to raise the fuel value of coke per unit of time the blast is increased, and with it the consumption of fuel augmented. The inferiority in the quality of iron produced in blast furnaces worked with coke, is mainly attributed to the lower heating power possessed by that material; this necessitates increased consumption of this fuel, which favours the reduction of phosphorus.—D. B.

Explosions caused by Coal Dust. R. Schneider. Oesterr. Zeits. Berg.-u.-Hüttenw. 32, 622, 638.

HILT has shown that coal dust cannot be ignited with dynamite, even when it is mixed with 5 per cent. of marsh gas. The author, on the other hand, refers to some experiments made at the Segen-Gottes pit, which proved that coal dust *per se* can be fired with cartridges charged with Nobel's dynamite No. 1.—D. B.

On some Properties of Zinc. L. L'Hôte. Compt. Rend. 101, 1153.

COMMERCIAL zinc is never free from iron, and often contains arsenic and antimony, hence it decomposes water at its boiling point with evolution of hydrogen, and is attacked by dilute sulphuric acid. Pure zinc, obtained by distilling a mixture of pure precipitated oxide of zinc and lamp-black, does not exhibit these properties.—D. B.

Improvements in the Manufacture of Pots for Melting and Desilverising Lead. J. C. Ridley, Newcastle-on-Tyne. Eng. Pat. 2835, March 3, 1885. 4d.

THE pots are to be made of cast or mild steel, either cast at once in the required shape or stamped from "blanks." They are thinner and withstand the frequent changes of temperature better than those of cast iron.—W. G. M.

An Improved Method and Means for the Continuous Oxidising and Desulphurising of Ores or Minerals. George Attwood, Ulster Place, Regents Park. Eng. Pat. 4285, April 7, 1885. 8d.

THIS is a continuous-acting calciner, preferably of kiln-shape, into which alternate layers of ore and fuel are constantly charged from above, and from which through a suitable orifice beneath the calcined ore is from time to time removed. The firing is aided by one or more grates at the side of the base of the kiln, and communicating

with it by means of flues. The raw ore is first crushed to a convenient size, from that of a corn of wheat to a lump of some three or four inches in diameter.

—W. G. M.

Improvements in the Process of Smelting Pyrites and in the Tuyères of Blast Furnaces to be used for the purpose, comprising also a Novel Method and Apparatus for Feeding such Furnaces. John Dixon, Frederick James Blades, William Selby Douglas, David Garlick, and William Malcolm, of Adelaide, South Australia. Eng. Pat. 10,621, September 8, 1885. 8d.

THE furnace employed is of the cupola type; it is supported on four pillars, and has a bottom which is made removable for convenience of repairs; it is provided with an arched cover made in sections, and with two tap-holes, the upper one being intended for the continuous removal of slag, the lower one for the tapping of the metal. A little above the lower tap-hole are placed the tuyère bricks, and again above this is a special apparatus for feeding in raw pyrites. This apparatus consists in a closed chamber having on its floor an air inlet, and on the opposite side a pipe for the discharge of air and dust pyrites into the furnace through suitable tuyères; from this box pass vertically upwards two metal pipes at some distance apart; running through these pipes, over a hexagonal slotted wheel above and round a similar wheel in the closed chamber, is an endless chain carrying at intervals steel discs of such size as to pass readily through the pipes. The rate of travel of the discs is regulated according to circumstances by a system of adjustable chain multiplying gearing without the closed chamber. The finely-crushed pyrites is elevated to a hopper above the downward or feeding pipe, and is conveyed by the onward motion of the steel discs, into the mixing chamber, whence it is carried by the heated blast into the furnace itself. In using the process, the ore is first finely pulverised and mixed to yield a good slag, and the furnace being heated and the blast let on, the ore is fed in through the movable cover until a fluid bath is obtained; the feeding apparatus is then cautiously started and the feed increased until the slag begins to flow from the upper tap. When the fluid mixture contains more than 60 per cent. copper, the slag contains a certain quantity of that metal, and must be retained; when 75 per cent. copper is reached the feed is stopped, and the rest of the blow conducted by the air tuyères alone. Rough copper is then run out until the level of the fluid has reached the feed tuyères, when the tapping is discontinued and the feed conducted as before. The quantity of feed will depend partially upon the atmospheric conditions, a fall of 4° F., or a rise of 0·27 inch, in the mercurial barometer demanding an increased supply of half-a-pound of ore per minute. —W. G. M.

Improvements in Producing Malleable Iron or Steel direct from the Ore and Apparatus therefor. W. P. Thompson, Liverpool and High Holborn. From Christian Husegavel, Finland. Eng. Pat. 14,924, December 5, 1885. 8d.

A SMALL blast furnace working with a large burden and at a low temperature is employed, so that the reduced metal never takes up sufficient carbon to render it fluid. The furnace walls, which are of iron, are double and air-cooled, the air being finally discharged into the blast furnace through the tuyères. The hearth of the furnace is fixed on a truck, and may be detached from the body of the furnace. Fluxes must be added to produce a fusible slag through which the pasty iron may sink and unite to form a lump with that already collected on the hearth. When this ball is of sufficient size the hearth is removed and tipped to remove the metal, another hearth previously heated being immediately wheeled into position. —W. G. M.

XI.—FATS, OILS, AND SOAP MANUFACTURE.

The Detection of Adulterations in the Preparation of Olive Oil. A. Audoumand. Compt. Rend. 1885, 101, 752.

THE author decomposes 2cc. of oil in a test glass 15m. length, 0·15 broad, with 1grm. powdered K_2CrO_7 , and shakes up for a few moments. Then a mixture of nitric acid and sulphuric acid is added, until the total volume amounts to 4cc., when it is again shaken, whereby the liquid becomes reddish-brown. After standing two minutes the volume is brought to 5cc. by the addition of ordinary ether, and then again shaken. After a few moments a violent effervescence takes place, nitrous fumes are evolved, and the oil rises to the surface with a characteristic colouration. Pure olive oil assumes a green colour, but if the oil contains at least five per cent. of sesame oil, arachis oil, cotton-seed oil, poppy-seed oil, the colouration is yellowish-green to yellow, or even yellowish-red. In order to observe these colours better, water is added. The colour remains several hours. The author has used this method with olive oils from very different sources, and considers that in this way it may be decided in fifteen to twenty minutes, whether an olive oil is pure—that is, whether it contains five per cent. of adulteration. —J. B. C.

XII.—PAINTS, VARNISHES, AND RESINS.

Gutta-percha from Bassia (Butyrospermum) Parkii. E. Heckel and F. Schlagdenhauffen. Compt. Rend. 101, 1069.

GUTTA-PERCHA from *Bassia Parkii* has a density of 0·976, becomes electrical by friction, and can be used for insulating purposes. It softens in warm water, becoming pasty as the temperature approaches boiling. It is more insoluble in light petroleum ether, oil of turpentine, and hot acetic acid, than ordinary gutta-percha. An examination, according to Payen's method, gave the following results:—

	Crude Borneo Gutta-percha.		Crude Gutta Bassia.	Gutta Purified with Carbon Bisulphide.	
	I.	II.		Com'l. I.	Bassia.
Gutta-percha..	92·0	91·5	91·5	92·0	91·5
Alban ..	6·0	6·5	5·5	5·8	6·0
Fluavil ..	2·0	3·0	3·0	2·5	2·5

Commercial gutta gives 1·26 per cent. of residue when incinerated, gutta bassia 1·20 per cent. Gutta bassia can be worked into any required shape when softened in warm water, and may be used with advantage for galvanoplastic purposes. —D. B.

Solubility of Caoutchouc. Hanausek. Zeits. Oesterr. Apoth. Ver. 23, 486.

THE statements as to the solubility of caoutchouc in different solvents varying considerably, the author made a number of trials, the following ratios of solubility being obtained:—

	Ceara.	Negro-head.	Sierra Leone.
100 parts of ethyl ether dissolve ..	2·6	3·6	4·5
100 " oil of turpentine dissolve ..	4·5	5·0	4·6
100 " chloroform ..	3·0	3·7	3·0
100 " petroleum naphtha ..	1·5	4·5	4·0
100 " benzene ..	4·4	5·0	4·7
100 " carbon bisulphide ..	0·1	—	—

Oil of turpentine and benzene appear to be the best solvents. —D. B.

The Action of Resins with Reagents. E. Hirschsohn. Pharm. Ztschr. Russl. 1885, 24, 529.

FROM the experiments of the author the following results have been obtained. Alcohol dissolves completely resin from "pinus silvestris" and "picea excelsa;" on the other hand, ether and chloroform dissolve only the former completely, the latter remaining partly undissolved. The same difference in solubility occurs with NH_4Cl and Na_2CO_3 solutions. —J. B. C.

XIV.—AGRICULTURE, MANURES, Etc.

Application of Alkali Waste to the Treatment of Parasitic Diseases. Duponchel. *Compt. Rend.* **101**, 898.

THE solution obtained by digesting alkali waste possesses in a high degree those therapeutic qualities which are found in natural sulphur waters, and can be used either alone or to increase the action of the latter. On account of its extremely low price it may be used for the parasitic diseases of plants, and promises to give excellent results in the case of the phylloxera. For the vine diseases produced by blight the author finds that a single application of this solution is much more efficacious than repeated doses of sulphur as applied in the usual way.

—J. H. H.

On the Treatment of Mildew with Copper Sulphate. A. Muntz. *Compt. Rend.* **101**, 895.

IN order to check the mildew which has of late years been a cause of much damage to some of the vineyards in France, the author has employed solutions of copper sulphate with much success. The vines treated in July with this solution retained their leaves, those not treated lost them. The grapes were enabled after this treatment to ripen completely, whilst those of vines not so treated, failed to do so. The following table clearly shows the difference :—

	Fruit on the Vines not treated.	Fruit on the Vines treated.
Mean weight	1.04grm.	1.45grm.
Sugar in 100grms. Must ..	9.10 ..	15.30 ..
Acids in 1 litre Must (calculated as H_2SO_4) ..	9.60 ..	5.20 ..

The vines were sprinkled by means of a small syringe with 25cc. of a 10 per cent. solution of $CuSO_4$. A 20 per cent. solution seems to give almost as good results, and no trace of copper is found in the wine made from these grapes. A mixture of lime and $CuSO_4$ seems to give still better results.—J. H. H.

On the Effect of a Mixture of Copper Sulphate and Lime upon Mildew in Vines. Millardet and Gayon. *Compt. Rend.* **101**, 924.

THESE authors have also observed the very excellent results of a mixture of lime and copper sulphate as a remedy against mildew in vines. The copper is deposited on the leaves as oxyhydrate, which is only soluble very gradually in water containing ammonium carbonate or carbonic acid in solution. The lime appears to have a three-fold action. In the first place it serves to retain the copper upon the leaves; then it effects the destruction of the spores for several days after its application, in consequence of its basic properties; and, finally, it transforms the copper hydrate into carbonate.—J. H. H.

Estimation of Copper in Vines which had been treated with a Mixture of Lime and Copper Sulphate, and in the Wine, etc., made from them. Millardet and Gayon. *Compt. Rend.* **101**, 985.

THE estimations were made at the time of the vintage. The undried leaves of four different kinds of vines contained respectively 0.0191, 0.0696, 0.0955, 0.0249grm. Cu per kilo. of the leaves. In the stalks of two kinds were found respectively 0.0151 and 0.0186grm. Cu per kilo. In the skins and stones of two kinds 0.0111 and 0.0219grm. Cu per kilo. were found respectively. Four must (vats) contained per litre 0.0014, 0.0012, 0.001, 0.0022grm. Cu. The wines themselves contained only the minutest and indeed doubtful traces of copper, at the most 0.1grm. per 1000 litres, for it is precipitated and found again in the yeast and sediment. Tannin and sulphur added before the fermentation of the must assist in this separation.—J. H. H.

Discovery of Phosphorite Deposits in the South of Tunis. P. Thomas. *Compt. Rend.* **101**, 1184.

THESE deposits were found by the author in the lower tertiary strata extending over a considerable area. The

phosphorites occur in the form of cylindrical coprolites, varying in dimensions, and of yellow clusters, weighing several kilos. The coprolite masses contain 70.8 per cent. of calcium phosphate, the yellow clusters 52.1 per cent., and the small clusters accompanying the latter only 3.34 per cent.—D. B.

Treatment of Lupines. T. Bente. *Pharm. Zeit. Handelsb.* 1885, **30**, 47.

THE author recommends the following process for freeing lupines from their bitter taste. Fifty kilos. of yellow lupines are first treated with a large quantity of spring water, so that, after soaking, they are still completely covered with water; one kilo. of hydrochloric acid free from arsenic is then added, and the mass is allowed to remain for twenty-four hours. One kilo. of a saturated aqueous solution of acid sulphate of calcium is now put into the vessel, the contents of which are stirred and then left for a further period of twenty-four hours. Finally, the fluid is drawn off, and the lupines are thoroughly well washed.

—E. G. C.

Nitrogenous Constituents of the Soil. G. Loges. *Landw. Vers. Stat.* 1885, **32**, 158.

By evaporation of an HCl extract of the soil the author obtained a nitrogenous residue. It may be possible in this way by extracting with HCl to separate humine from nitrogenous humus bodies.—J. B. C.

The Behaviour of Starch and Sugar in Tobacco Leaves. H. Müller-Thurgau. *Landw. Jahrb.* 1885, **14**, 485.

FERMENTED crude tobaccos do not contain, as a rule, starch or sugar, or only small quantities. The quantity of starch in fermented tobacco is, however, no criterion of its quality. Tobacco leaves dried quickly in the sun always contain starch. During the ripening process the under leaves contain less starch than the upper ones, because they are shaded, and attain a greater degree of over-ripeness than the upper ones. The quantity of sugar contained in the fresh, ripe leaves is comparatively small. It increases by drying on the first day, and then diminishes with time. Quickly dried leaves contain a smaller quantity of sugar than those more slowly desiccated. After drying, the sugar present disappears completely during the process of fermentation. The starch, however, does not appear to be influenced.—J. B. C.

XV.—SUGAR, GUMS, STARCHES, Etc.

On the Sources from which Melitose (Raffinose) is obtained in the Manufacture of Sugar. E. O. v. Lippmann. *Ber.* **18**, 3087.

THE author proves that melitose exists already in the beet. This explains both the abnormally high polarisation equivalent and the difference which has been observed between the results of an optical and chemical examination of the beet-juice. (This Journal, iv. 505 and 607.)—J. H. H.

The Clarification of Sugar Solutions. *Sucrerie Indigène*, 1885, **26**, 295.

SODIUM THIOSULPHATE has the property of clarifying those syrups which still remain muddy and dark-coloured, even after the addition of lead acetate.—J. B. C.

Alcoholic Extraction of Beet-sugar. *Ztschr. f. Zucker. Ind.* 1885, **35**, 806.

SUCHOMEL has found, after many years' experience, that Scheibler's data are fully reliable—namely, two hours suffice for extraction, and four hours with very woody beets. A quantity of 40—50grms. of mash gave the same result as the full sample of 3—4kilos., if the preparation and mixing had been carefully done. By dry-

ing and weighing the extract residue, the author determined the crude marc, and found 4–5 per cent. Old beets gave 7.09 per cent.; very woody beets 7.07 per cent. of residue. The statement, therefore, that such beets only contain 80 per cent. of syrup, and therefore 20 per cent. of residue, is quite misleading. Lixivated beet cuttings give twice as much sugar on extraction as by the usual method of pressing, and these results agree with those obtained by Stammer's excellent method.

—J. B. C.

Notes on the Analysis of Finished and Intermediary Products of Sugar Works. L. Harperuth. Chem. Zeit. 9, 1711; and 10, 51.

THE author intends to deal, in a series of articles, with the mode of controlling the operations performed in beet-root sugar works, and his experience of many years leads him to the conclusion that it is absolutely necessary to test regularly the composition of the finished and intermediate products. The analysis of a raw sugar, for instance, ought to contain—1, total dry matter; 2, sugar; 3, non-sugar (invert-sugar and raffinose); 4, factor of purity; 5, ash; 6, refining value ("rendement"). In the beet-root department the control ought to relate to—1, beet-root; 2, washed and cleaned beet-root slices; 3, spent slices as they leave the dials; 4, raw juice; 5, thin juice, unfiltered and filtered; 6, filter-press cake; 7, syrup, unfiltered and filtered; 8, fill-mass of first quality; 9, raw sugar of first quality and the syrups, fill-masses, sugar and molasses of inferior quality. His apparatus for submitting sugar-juice to the action of animal charcoal under variable circumstances is represented in Figs. 1 and 2. A glass cylinder (Fig. 1) has



FIG. 1.

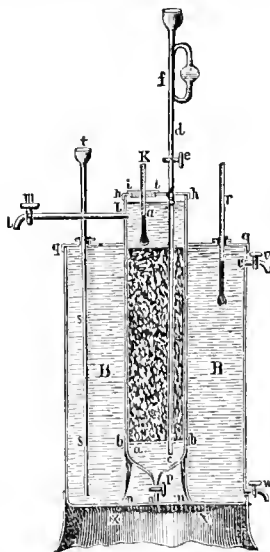


FIG. 2.

two overflows, *a* and *b*; *a* for the discharge of the filtered solution, *b* for running off the liquid completely. The solution enters through the funnel *c* at the bottom, and after passing through the whole length of charcoal, overflows at *a*. If it be desired to treat the juice with charcoal at a constant heat, the apparatus shown in Fig. 2 is employed, where *A* is a glass cylinder filled with animal charcoal, and *B* an iron water-bath, which communicates heat to *A*. The arrangement of the other parts will easily be seen from the diagram. The author's many experiments show that, for an exact analysis, the decolourisation of sugar solutions with animal charcoal involves error; even for technical analysis an addition of tannin is absolutely necessary.—S. H.

Oxidation of Levulose. E. Börmstein and A. Herzfeld. Ber. 18, 3353–3357.

THE authors mention the work which has been done on the subject, and point out that Habermann and Honig

(*Monats. Chem.* 3, 651) found an acid of higher molecular weight than glycollic acid, the constitution of which they were unable to determine. In order to prevent the oxidation products being themselves decomposed by the use of too strong an oxidising agent, the authors used for their experiments a mixture of mercuric oxide and baryta-water. They proceeded as follows:—An aqueous solution of levulose syrup, prepared from inulin, was heated on a water-bath with mercuric oxide, and a small quantity of pure barium hydrate solution added; the red mercuric oxide is immediately reduced to black mercurous oxide. The addition of these two substances was continued in small quantities until a portion of the liquid, after removal of the barium with sulphuric acid, gave no reduction with Fehling's solution. About ten to twelve times as much mercuric oxide as barium hydrate is required for the reaction. The liquid was then filtered from the insoluble mercurous oxide, etc., the excess of barium hydrate removed with carbonic anhydride, the liquid evaporated, filtered, and sulphuric acid added to exact precipitation of the barium present, and the acid liquid distilled with frequent addition of water until all volatile acid had come over. The volatile acid consisted entirely of *formic acid*. The residue was then shaken with ether. The calcium salt of the acid soluble in ether gave numbers on analysis, proving it to be *glycollic acid*. The greater part of the oxidation product remains in the residue, and is not soluble in ether. The calcium salt of the acid remaining in solution forms a yellow syrup, which does not become solid when exposed over sulphuric acid in vacuo, but which can be obtained as a white crystalline powder on repeated treatment of the syrup with strong alcohol. On analysis, this salt gave numbers corresponding to the calcium salt of a *trihydroxybutyric acid*. The free acid forms a thick syrup, which, on reduction with hydriodic acid and amorphous phosphorus, yielded, in addition to an undetermined volatile acid, a lactone; the acid, therefore, is probably *normal trihydroxybutyric acid*. The authors conclude that the constitution of levulose is probably expressed by the formula $\text{C}_6\text{H}_{10}\text{O}_7 \cdot \text{CO} \cdot \text{CHOH} \cdot \text{CHOH} \cdot \text{CHOH} \cdot \text{CH}_2\text{OH}$. They promise further work upon the subject, and also announce their intention of studying the action of bromine on an aqueous solution of levulose.

—G. H. M.

XVI.—BREWING, WINES, SPIRITS, Etc.

On Aspergillus Oryzae. Bot. Centr. 24, 62.

FOR the preparation of "saké" the Japanese use the above-named fungus. Rice is treated with tane-koji, a greenish powder consisting of the spores of the fungus. As soon as the grains of rice have developed mycelium the grain is kneaded together and dried in the air. The resulting product, called "koji," is treated with four volumes of steamed rice. "Koji" contains a powerful substance, acting like diastase, and capable of producing a large amount of dextrose and soluble albumenoids. It begins to act at 0°, gives the most favourable results at 50°, and is destroyed at 60–70°. After the fifth day fermentation sets in and a mass results which is called "moto." This is worked up in conjunction with steamed rice and "koji" in the regular process for the brewing of "saké."—D. B.

The Application and Use of an Improved Salt in Brewing. A. Boake and F. G. A. Roberts, Stratford. Eng. Pat. 5883, May 13, 1885. 4d.

IN this patent the use of "potassium anhydrometa-," or "iso-bisulphite" (Eng. Pat. 5882, 1885), is claimed in any stage of the process of brewing, either to the materials before mashing or to the wort before or after fermentation, and also to the finished beer in casks. The quantity to be used is three ounces to every quarter of malt, or its equivalent in malt substitutes, employed.

—G. H. M.

On Wines manufactured from Dried Grapes, etc. F. Schaller. Zeits. Anal. Chem. 24, 559.

IN spite of the steady increase in the number of artificial wine manufactories in France, Switzerland, and else-

where, there are few published analyses of the manufactured wines, and still fewer sources of information as to the points of difference between these products and natural wines. Besides raisins and emments, sugar, tartaric acid, and many other substances are used in the manufacture of artificial wines, into the composition of some of which the dried grapes have entered to but a small extent. The author gives the following results of the analyses of a few samples of manufactured wines:—

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
	100cc. CONTAIN					
Alcohol, volume percentage ..	8.05	9.55	7.02	6.70	6.75	10.65
Extract	2.395	1.962	1.797	1.290	1.580	2.33
Sugar	0.320	0.409	0.324	0.330	0.280	0.625
Ash	0.209	0.135	0.160	0.070	0.155	0.185
Acidity (= Tartaric Acid)	0.743	0.510	0.772	0.570	0.398	0.450
Free Tartaric Acid	—	traces	traces	0.211	traces	—
Crcao of Tartar	0.264	0.227	0.471	0.152	0.208	0.180
CaO	—	—	0.0192	—	—	—
SO ₂	0.0374	—	—	—	—	0.0477
P ₂ O ₅	0.0196	0.0135	0.0172	—	—	0.0095

No. 6 was mixed with about 10 per cent of a plastered Spanish wine.—E. G. C.

possible to attain by artificial means; the dough expands in the oven, becomes hard, and loses water. The whole loss is limited to the crust, as the crumb does not contain less water than the dough. Under the influence of heat the proportion of sugar is increased and the fatty substance is diminished. The crust contains more sugar and less fat than the crumb. The expansion of the bread is produced by steam and carbonic acid formed in its preparation. As soon as the bread is taken out of the

oven steam condenses, and the air then entering drives out moisture.—J. B. C.

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

(A) CHEMISTRY OF FOODS.

Importance of Edible Fungi as Human Food. R. H. Saltet. Arch. Hygiene, 3, 443.

THE author corroborates the well-known fact of the richness in nitrogenous constituents of edible fungi. He has found 6.8 per cent. of nitrogen in the dried substances of French preserved mushrooms (*champignons*). Contrary to the prevailing opinion as to the digestibility of edible fungi, it is shown that only 75 per cent. of the dried substance is digested; so that edible fungi should not be grouped with animal food, as is frequently done.

—D. B.

Preparation of Bread. Balland. Journ. Pharm. Chim. 1885, 5, ser. 12, 103, 202, 255, 299.

THE results of the following investigations of the author are as follows:—The fermentation of the bread is produced by the natural ferment of the corn, and the process during the preparation of bread is attributed to the action of heat and water in producing activity of the ferment. At first, the glutinous matter becomes hydrated and thin, whereby the necessary firmness is given to the dough, which the starch alone cannot produce. The altered gluten forms, at the same time, a movable network, in which the gases formed are retained. It also gives the bread, when brought into the oven, its particular form. One of the most important points in the preparation of bread is to know the moment in which the gluten possesses its maximum of cohesion. If the action goes on too far the gluten becomes liquid, and does not retain the gases. These escape, and the bread becomes sad. At the same time as the gluten becomes hydrated the starch undergoes the same process, and under the influence of these changes the formation of acid and sugar appear, which do not pre-exist in the cereal. Among the products of decomposition of the sugar, carbonic acid and alcohol are found. All these changes are completed with yeast under the influence of the natural ferment with a regularity which it is not

The Presence of Alkaloids in Old Flour. Balland. Journ. Pharm. Chim. 1885, 5, ser. 12, 341.

FLOUR kept for years in sacks contains alkaloids. The flour is extracted with ether, evaporated on the water-bath, and the strongly-smelling residue taken up with a small quantity of warm water. After again warming for a few minutes on the water-bath, the presence of alkaloids may be detected by reagents, such as potassium, mercuric iodide, ferrieyanide of potassium, and ferric chloride. The alkaloids may be detected one to one and a-half years after grinding the flour. The author ascribes the formation to the action of a ferment upon the glutinous matter of the flour.—J. B. C.

(B) SANITARY CHEMISTRY.

Improvements in the Treatment of Sewage, etc. J. W. Slater, London. Eng. Pat. 4532, April 13, 1885. 6d.

THE essential feature of this invention is the employment, for the treatment of sewage or polluted water, of a water naturally impregnated with alumina. The patentee makes six claims, in which, in addition to the use of the water alone or in conjunction with a water naturally impregnated with iron, salts of alumina, iron, carbon, blood, clay, and any soluble salt of magnesia are severally or collectively used therewith.—C. C. H.

Improvements in the Filtration of Sewage and in Apparatus therefor. C. Price and H. Cleave, Leicesters. Eng. Pat. 2728, February 28, 1885. 8d.

THE sewage is received in a tank containing a cylinder, or tank similar in every respect to the dome of a gasometer. This is filled with air by a force-pump, which causes it to rise, and so exercise a pressure upon the sewage, forcing it (1) upwards through a column of coarse coke; (2) downwards through a column of finer coke; (3) upwards through a column of sand. The solid matter accumulates at the lower part of the chambers, and is removed periodically through openings formed in the walls.—C. C. H.

XVIII.—ELECTRO-CHEMISTRY.

**The Condensation of Dust and Smoke by Electricity.* C. F. Guitard. *Mechanics' Magazine*, October 29, 1850.

"SOME time since, in experimentalising on the electric state of the atmosphere, I employed for that purpose, a large glass cylinder about 18in. high and 9in. diameter, open at bottom and having a neck at top. In placing the lower end of this cylinder in water, the more perfectly to exclude the air, and allowing small quantities of tobacco smoke to enter the neck at top, the smoke, after assuming various actions, according to, probably, the hydrometric state of the atmosphere, would gradually spread itself into a cloud filling the cylinder, and at length, as successive portions came in contact with the sides of the cylinder, condense. Sometimes half-an-hour would elapse before this effect took place. It now struck me that if I brought a wire from an electrifying machine into the neck of the cylinder, the air would immediately become charged with electricity, which would cause each portion of the smoke to fly to the sides of the cylinder, and that thus more rapid condensation would take place. The effect produced was perfectly magical. The slightest turn of a small electrifying machine produced immediate condensation. It was astonishing to see how small a quantity of electricity produced a most powerful effect. I am not aware that attention has ever been drawn to this subject; and the question will probably arise, Has electricity anything to do with the condensation of steam in the condenser?"

The Manufacture of Improved Plastic Compounds. R. E. Goulden, Hanover Square, London. Eng. Pat. 2742, February 28, 1885. 4d.

IMPROVED plastic compounds suitable for insulating material for galvanic batteries, are made by mixing, and combining by heat gum damar, gum kamri, gutta-percha and asbestos or other suitable pigment.—W. B.

Improvements in the Manufacture of Electrical Batteries. L. P. Merriam, Romerton. Eng. Pat. 3888, March 26, 1885. 4d.

IN order to prevent leakage of the solution or liquid in electrical batteries at the joints of a cell or trough, the author proposes to form the joints by means of xylonite or some other pyroxylin compound which is not affected by ordinary battery solutions or liquids.—W. B.

Improvements in the Manufacture of Nickel and Cobalt. H. Wiggin, H. A. Wiggin, A. S. Johnstone, and W. W. Wiggin, Birmingham. Eng. Pat. 3923, March 27, 1885. 6d.

THIS is a process for separating copper from nickel and cobalt, and consists in obtaining the metals in solution, preferably as chlorides, sulphates or nitrates, by well-known methods, and subjecting the solution to the action of an electric current. With a cathode of copper or brass and an anode of compressed carbon, the copper is reduced by the electric current and deposited on the cathode, and the chlorine or acids which were combined with the copper are liberated at the carbon anode.

—W. B.

Improvements in Boxes or Cells for Primary and Secondary Batteries. Charles Mosley, Manchester. Eng. Pat. 4155, April 2, 1885. 4d.

IN a box or cell of a primary or secondary battery is secured a lining of indiarubber; or an indiarubber com-

pound is cemented therein. To prevent the creeping of the solution over the top edge of the box or cell, the upper edges of the lining are coated with paraffin or some such analogous substance.—W. B.

Improvements in and connected with Galvanising Baths. Thomas Minnis, Wolverhampton; and E. Ingram, Birmingham. Eng. Pat. 4584, April 14, 1885. 6d.

By this method three adjustable rollers are used in a galvanising bath, whereby a saving of flux is effected on the delivery side of the bath.—W. B.

Improvements in Voltaic Batteries. A. R. Bennett, Glasgow. Eng. Pat. 5256, April 28, 1885. 4d.

WITH the object of increasing the constancy of the current produced by the various forms of voltaic batteries described and claimed in the specifications of the author's patents Nos. 302 of 1882, and 1901 of 1882, he employs, in conjunction with the chemicals therein set forth, metallic sulphides, more particularly the various sulphides of iron and copper, and the joint sulphides of iron and copper.—W. B.

Improvements in Galvanic Batteries and in the Electrodes of Electrolytic Converting Tanks or Troughs. W. H. Tasker, Bedford Square; and T. J. Jones, Princes Street. Eng. Pat. 8627, July 16, 1885. 8d.

THIS invention relates to the construction of elements for galvanic batteries, particularly the negative elements of lead primary batteries, and it has for its principal object to provide a support for the active material. The support consists of an inoxidisable substance, of any desired form, which is slit for the passage of strips of foil, the said strips being laced or passed through the slits to and fro from side to side so as to afford good contact with the active material on both sides of the support, and practically utilise the whole or greater part of the external surface of the foil for this purpose.

—W. B.

Improvements in the Production of a Carbonisable Material suitable for the Manufacture of Carbons for Electric Lamps, etc. F. Wynne, Westminster; and L. S. Powell, Notting Hill. Eng. Pat. 16,805, December 22, 1885. 6d.

A TRANSPARENT horny substance, suitable for electric lamps, is produced by dissolving cellulose in the form of cotton or other vegetable fibre or fabric in solutions of the chlorides, iodides or bromides of zinc or bismuth, and precipitating by alcohol, ether, acetic acid, etc.—W. B.

XIX.—PAPER, PASTEBOARD, Etc.

Machinery or Apparatus for Separating, Washing, and Drying Fibre from Peat. F. Baird, London. Eng. Pat. 860, October 16, 1885. 8d.

THE separating and washing is effected by the use of a series of drums placed in a tank of water. The material, fed through a hopper, passes between two plain drums (which simply reduce its thickness) on to an endless chain, which carries it to another pair of drums. These are provided with teeth, which manipulate the peat into fine fibre and throw it into a washing-tank, whence it is conveyed to a strainer and afterwards to a drying-room.

—A. R. D.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

Action of Light on Iodoform. G. Dacombe. *Ann. di Chim.* 1885, 209.

THE decomposition of iodoform in sunlight with separation of iodine is effected only in the presence of oxygen, in which case the reaction is complete. The following equation expresses the change which occurs:— $2\text{CHI}_3 + 5\text{O} = 3\text{I}_2 + 2\text{CO}_2 + \text{H}_2\text{O}$.—D. B.

* Mr. W. M. Hutchings, of the Dee Bank Lead Works, Bagilt, North Wales, forwarded the above verbatim extract, and desires moreover to draw attention to *Berg. und Hütten-männische Zeit.* June 19 and July 10, as also to *Engineering*, June 5, 1885, where articles on the above subject occur. In view of recent investigations of this subject, it was thought interesting to reproduce here what was probably the first observation of these electrical phenomena.

Green Colour imparted to Dilute Solutions of Apomorphine Hydrochloride. Bernbeck. Pharm. Zeit. **30**, 874.

WEAK solutions of apomorphine hydrochloride gradually undergo decomposition with formation of an emerald-green colouration. This change is attributed by the author to the presence of ammonium carbonate in the water used for dissolving the hydrochloride, or in the atmosphere, especially the air of sick-rooms. A small amount of hydrochloric acid prevents the formation of this colouration.—D. B.

Green Colouration exhibited by Apomorphine Solutions. E. Mylius. Pharm. Zeit. **30**, 883.

THE green colouration assumed by apomorphine solutions is attributed, not only to the action of ammonia, but to that of the fixed alkalis.—D. B.

Comparison of the Ethereal Oils of Mentha Piperita and Mentha Viridis. H. Trimble. Amer. Apoth. Zeit. **6**, 492.

BOTH oils contain the same hydrocarbon, $C_{10}H_{18}$. The latter is present, however, in smaller quantity than hitherto assumed, and cannot be isolated without difficulty. The oxidised constituent in the oil of *mentha viridis* is carvol $C_{10}H_{12}O$, that of the oil of *mentha piperita*, pimenthol $C_{10}H_{20}O$, a body which is solid and crystalline at the ordinary temperature.—D. B.

African Cinchona Bark (so called). E. Heckel and Schlagdenhaufen. Ann. Chem. Phys. **6**, 313.

BOCHEFONTAINE, FERIS, and MARCUS have found an alkaloid called "Doundakine" in African cinchona bark. The authors, on examining this bark, obtained the following results:—

Soluble in petroleum spirit: Wax, fatty bodies	1.200%
" " chloroform: Wax, fatty bodies, and colouring matters	1.040
" " alcohol: Traces of tannin, glucose, and resinous colouring matters	6.950
" " acidulated water: Albumenoids and amylaceous substances, salts	23.112
Woody fibre	62.128
Salts	5.570

100.000

They deny the existence of the above alkaloid. The physiological action of the bark is due to the presence of a colouring matter, for which the authors propose to adopt the name "Doundakine." The bitter taste of African cinchona bark is caused by two nitrogenous colouring matters of resinous consistence, distinguished by their different solubilities in water and alcohol. African bark possesses tonic and febrifuge properties.—D. B.

New Nitrogenous Constituent of Vetches, etc. E. Schulze and E. Bosshard. Zeit. Physiol. Chem. **10**, 80.

THIS substance, called *Vernine*, was prepared as follows: Young leaves of the common vetch (*Vicia sativa*) and the red clover (*Trifolium pratense*) were dried, ground, and exhausted with hot water. The extract was treated with lead acetate and mercuric nitrate, and the resulting precipitate decomposed by hydrogen sulphide. The filtrate was neutralised with ammonia and concentrated by evaporation. Besides crystals of asparagine an amorphous precipitate was separated which, when recrystallised from hot water, gave shining needles of vernine, having the composition $C_{16}H_{26}N_4O_8$. Vernine has been extracted also by the authors, in conjunction with Hungerbühler, from blighted corn, 1 kilo. of substance yielding about 1 gram. of vernine.—D. B.

Hopine, the Alkaloid of Hops. Dr. W. Williamson. Chem. Zeit. **10**, 20, 38.

SEVERAL writers have supposed that the hop contained an alkaloid, and Griessmeyer described a crystallisable compound containing nitrogen, which gave a number of

the reactions peculiar to vegetable alkaloids. Still, as no one had obtained it in sufficient quantity for analysis, the author undertook an investigation of this most important constituent of the hop, and at last obtained the pure alkaloid from the American wild hop. The German and English hops contain very little hopeine, and its separation from the colouring matter of the plant offers in their case insuperable difficulties, though doubtless some is present. A wort of twelve per cent. strength was first made from as many hops as the brewing pan would hold; this was then boiled down at $45^{\circ}C$. in a vacuum pan of 10,000 litre capacity to a thick syrup. This product, in the case of the American wild hop (*Humulus Lupulus L.*), had a powerful narcotic effect, weaker in the case of English hops and weakest of all with German hops. The extraction of the pure alkaloid from this solution cannot, however, be effected, but by heating with alcohol an extract is obtained which is not inferior to opium in narcotic properties, and has an intensely bitter taste. A few grains of this alcoholic extract killed dogs and rabbits in less than two hours. As, however, it was not possible to obtain the pure alkaloid by a direct extraction of the hop or *Lupulus* with alcohol, a twelve to sixteen per cent. slightly acid sugar solution was poured upon the hops contained in large copper hermetically closed boilers. The sugar solution was as pure as possible, heated to $60^{\circ}C$. before addition to the hops, left with them for 24–48 hours, then boiled about six hours and quite cooled, and the hops separated from the liquid by a centrifugal machine. The sugar extract was then filtered, evaporated as far as possible in a vacuum in order to avoid the formation of caramel, as this body, if formed, makes the isolation of the alkaloid almost impossible. The evaporation was continued until upon cooling a solid mass of sugar was obtained, which upon pulverising formed a tolerably dry powder. This powder, which is coloured yellow by the hops and an extract with alcohol, leaves upon evaporation to dryness a clear brown residue which possesses all the properties of a narcotic alkaloid. This residue was again extracted with alcohol, and by successive treatment with weak ammonia water, ether, chloroform and benzene, the impurities were eliminated and the pure hopeine obtained by repeated crystallisation. Hopeine appears most nearly to resemble morphia, from which, however, it can easily be distinguished both by taste and by several characteristic reactions. In the pure state hopeine forms colourless prismatic needles or rhomboids, according as the mother-liquor contains more or less alcohol. The crystals must be dried in vacuo, or they assume a yellowish tint. Its formula when crystallised from 80 per cent. alcohol is always $C_{18}H_{26}NO_4 + H_2O$; when crystallised from 20 per cent. alcohol it always contains two molecules of water of crystallisation. The powder dried at $80^{\circ}C$. always has the composition $C_{18}H_{26}NO_4 + H_2O$. Upon heating to $110^{\circ}C$. in the air, or $75^{\circ}C$. in vacuo, all the H_2O evaporates, and at a higher temperature in the air decomposition takes place, whilst in vacuo it volatilises undecomposed.

The salts are mostly soluble in water and crystalline; pure hopeine is only soluble in 800 parts of water at $15^{\circ}C$. or about 50 of alcohol; in ammonia and ether dissolve about 0.1 per cent., chloroform not more than 0.2 per cent. Heated to 80° or $90^{\circ}C$. with a little alcohol, discolouration and partial decomposition set in.

Hopeine Sulphate $2(C_{18}H_{26}NO_4) \cdot H_2SO_4 + 4H_2O$.—Very easily soluble in water; crystallises from aqueous alcohol in forms very similar to the pure hopeine. *Hopeine Hydrochloride* is less soluble in water than the sulphate, and like all the haloid compounds is stable in the air; it crystallises with three molecules of water. The *Iodide* and *Fluoride* are similar, but still less soluble. The *Acetate* $C_{18}H_{26}NO_4 \cdot C_2H_3O_2 + H_2O$ is easily soluble in water and decomposes readily in air. In many of the salts the water of crystallisation varies according to their mode of preparation, as, for instance, the *Tartrate*, which may contain three, four, or five molecules of water. The *Salicylate* is easily crystallisable, fairly soluble, and very stable. The author states that the

very small yield of hopeine from a large quantity of hops, and the difficulty of treating such a large bulk of material, have induced him to continue his research with the so-called lupuline or hop-meal, from which he hopes for better results. 0.15–0.22grm. of the hopeine kill most animals. Smith and Roberts have shown that injected subcutaneously its action exceeds that of morphia, and internally applied it is certainly not less potent. It is also an antiseptic of the first rank, more powerful than any of the other alkaloids. These results correspond with the action of hops, which are known to retard fermentation and putrefaction in the highest degree.—J. H. H.

On Hopeine. A. Ladenburg. Chem. Zeit., 10, 319.

HAVING obtained, through Dr. Krause, a small quantity (0.47grm.) of the hopeine prepared by Dr. Williamson himself, the author states that he succeeded in separating the so-called hopeine into two bodies, the one with difficulty soluble, the other much more easily soluble in amyl alcohol. The properties of the former are identical with those of morphia, but the latter is a base requiring further investigation. This more soluble base yields no colour reactions either with ferric chloride or with sodium molybdate and sulphuric acid. It is not soluble in excess of soda, but is tolerably easily soluble in ether containing water.—W. S.

Examination of Oil of Mint for Turpentine. H. Hager. Pharm. C.-H. N. F. 1885, 589.

THE author is of opinion that turpentine is rarely mixed directly with the oil of mint, but that it is poured upon the mint when in the retorts, and that much of it remains behind there. The oil thus incorporated with turpentine differs materially in physical and chemical properties from that merely mixed with distilled turpentine. But the presence of turpentine is shown at once by employing the following method: 0.15grm. powdered guaiacum resin are placed in a dry test tube, and fifteen to twenty drops of alcohol added; the mixture is then heated to boiling, 1cc. of oil of mint, 1cc. of benzene or petroleum spirit, and five to six of oil of citrocelle added, and the mixture gently agitated and heated for some time to boiling. This solution, with the pure oil, has a brownish yellow tint, but if turpentine be present a violet colour is produced.—J. H. H.

Contributions to the Knowledge of Cocaine. E. Polenske. Pharm. Rundsch. 3, 250.

THE amount of alkaloid in coca leaves varies from 0.05 to 0.75 per cent., and depends on the method of drying adopted, the mode of packing and shipping. According to the author, coca leaves contain only one alkaloid, all other organic bases observed in the leaves being decomposition products of cocaine. Besides its physiological properties, cocaine may be distinguished by its slight solubility in water (1:2500 at 15°). When dilute solutions of the hydrochloride are treated with ammonia and carbonated alkalis, the liquid assumes a milky turbidity, solidifying after a while to a crystalline mass. Cocaine hydrochloride crystallises from water in long silky needles, containing two molecules of water.—D. B.

On the Detection of Cocaine. Prof. Curtman. Pharm. Rundsch. 1885, 252.

COCAINE is a strong reducing agent. The author mixed a freshly prepared solution of pure ferrieyanide of potassium with ferric chloride, and shaded the mixture from the light. He moistened filter paper with this solution, and then applied in a darkened room equivalent portions of solutions of the alkaloids. Morphia gave the blue reaction in less than half-a-minute; cocaine, in 1½ minutes; brucine, in 6; quinine, in 7; cinchonine, in 10; while strychnine and veratrine gave no trace of blue after standing a quarter-of-an-hour.

Of the other tests, the most reliable seems to be that based upon the formation of benzoic acid upon warming with weak acids. The benzoic acid can afterwards be detected in the usual manner.—J. H. H.

The Decomposition of Oil of Turpentine into an Active Terpene. G. Bonchardat and J. Lafont. Compt. Rend. 1886, 102, 50.

1200GRMS. of oil of turpentine carefully fractionated between 155–157° were dissolved in an equal volume of glacialacetic acid and treated with an acetic acid solution of 880grms. crystallised chromic acid, the latter being slowly added to the solution of the oil maintained below a temperature of 40°. No CO₂ escaped, and, although the larger portion of the oil was not oxidised, it nevertheless underwent a distinct change. A product, having the formula C₁₀H₁₆, and boiling at 174–178°, which the authors call levorotatory terpene, was isolated. Its properties are entirely different from those of turpentine oil. Its smell recalls that of oil of lemons. This terpene contains about one-sixth its weight of cymene, from which it could not be separated. Its rotatory power was found to be (α)_D = -56°, that of citrene being +104.9°. The chemical properties of the two bodies are identical.—J. B. C.

The Alkaloids of Aconitum Napellus. Alexander Jürgens. Inauguraldissert. Dorpat, 1885.

THE following are the results of the author's studies on this much-discussed subject:—(I.) Only pure crystallised aconitine should be used as a pharmaceutical preparation. (II.) The occurrence of picro-aconitine, napelline, and aconelline in the roots of the acon. nap. has not been proved. (III.) The presence of aconitine in forensic chemistry can only be detected with the help of physiological experiments. The formula for pure aconitine is C₃₄H₄₈NO₁₂. The colour reactions with phosphoric acid, sulphuric acid and sugar, phospho-molybdic acid and ammonia, affirmed by different authors, are not produced by the pure compound.—J. B. C.

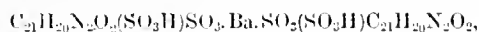
The Detection of Gamboge. E. Hirschsohn. Pharm. Ztschr. Russl. 1885, 24, 609.

GAMBOGE dissolves in petroleum spirit with an intense yellow colour. This solution is decolourised on shaking with solutions of NH₄Cl, NaOH, borax, and Na₂CO₃, the resin being extracted from the petroleum. If to the petroleum extract of gamboge a few drops of an alcoholic ferric chloride solution be added, the alcohol at the bottom of the test-glass is coloured intensely black. If two to four volumes of a solution of ammonia in petroleum be added, the resin is precipitated, and is no longer soluble in petroleum spirit. The author has devised from these reactions the following method for detecting gamboge:—The sample is finely powdered, and treated with petroleum spirit. If the extract be colourless, the shaking must be repeated, with the addition of HCl, as in presence of soap the gamboge is not dissolved. If the extract still remains colourless, gamboge is not present. If a yellow solution is obtained, a portion is shaken with dilute NaOH (1:100); and if a red colouration occurs from the presence of rhabarber and radix. lapat. it is saturated with ammonia gas, and the precipitated resin separated. The precipitate dissolved in alcohol should turn black with Fe₂Cl₆.—J. B. C.

On the Sulphonic Acids of Strychnine. C. Stoehr. Ber. 18, 3429–3432.

CRYSTALLISED strychnine, melting-point 265–266°, when heated with the necessary quantity of concentrated sulphuric acid at 100°, forms a monosulphonic acid, with a nearly quantitative yield. According to Loebisch and Schoop, under these conditions strychnine is not attacked. This monosulphonic acid, C₂₂H₂₁N₂O₂.SO₃H, is a colourless substance, very little soluble in water or alcohol. The ammonium salt is very soluble in water,

from which alcohol precipitates it; the potassium, sodium, barium, calcium, lead and copper salts form very insoluble precipitates. Concentrated sulphuric acid and sulphuric anhydride at 150° form readily a disulphonic acid, the yield being also good. The free acid, $C_{21}H_{20}N_2O_2(SO_3H)_2$, is a colourless amorphous substance, soluble in water, slightly soluble in alcohol, ether and benzene. Its normal barium salt, $C_{21}H_{20}N_2O_2(SO_3)_2Ba$, forms colourless tables or cubes; the hydrogen-barium salt—



a pale yellow amorphous powder is obtained by adding hydrochloric acid to the solution of the normal salt.

—T. L. B.

XXII.—GENERAL ANALYTICAL CHEMISTRY.

A Vacuum-Desiccator with a Heating Arrangement.

J. Prakt. Chem. 9, 425.

THE arrangement consists either of a steam-coil (Fig. 1) into which a metal basin is placed serving as a sand-bath, or of a jacketted copper dish (Fig. 2) which heats

FIG. 1.

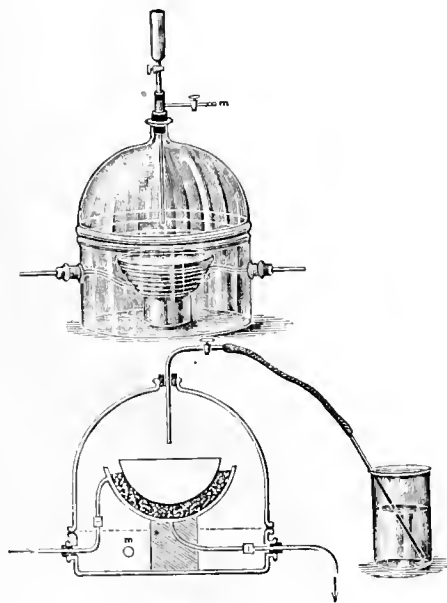


FIG. 2.

the sand by means of steam. For the purpose of boiling down large quantities of liquid in a vacuum, the solution is run into the evaporating basin either from a funnel at the top (Fig. 1) or is sucked from a beaker as shown in Fig. 2. The connection with the air-pump is at the bottom at *m*. When all is evaporated a slow current of dried air is passed over the dish, which promotes the drying considerably.—S. H.

Improvement in the Soxhlet Extraction Apparatus.

Chem. Zeit. 10, 52.

THERE is a disadvantage in connection with the Soxhlet apparatus that the siphon tube through which the ether flows back into the flask has an unalterable length. The mass to be extracted may take up more or less space, and in the latter case the amount of ether lying above the mass takes no part in the extracting process. To remedy this drawback it is suggested to use hollow glass cylinders, having a conical top and a small hook, to withdraw them readily if not wanted. They are a little thinner than the body of the apparatus, and high enough

just to reach to the overflow of the siphon tube. They are also loaded with a drop of mercury to prevent them from floating.—S. H.

A Non-metallic Gas-regulator. II. Schidl. Ber. 18, 2833–2841.

THE form of the apparatus is given in the diagram, Fig. 1.

A tube A, closed at its lower end, stands upon a wooden foot, which also supports the whole apparatus. Two side pieces of tubing are fused on to the lower end of the tube A, and an inverted bottle B of capacity $\frac{3}{4}$ –1 litre with the bottom removed fits over the upper portion. The bottle is filled with water. In this a $\frac{1}{2}$ -litre flask C, with neck detached, floats, and surrounds the vertical tube, leaving a space of about 2mm. The flask moves a glass lever D fixed by a cork or caoutchouc plate 3mm. thick into the bulb of the cross piece E. The short arm D within the bulb is flattened, and to its lower surface a small piece of caoutchouc is attached. The plate forms a valve to the tube F, the upper end of which is drawn out so as to form an opening of about 2mm. diameter, and this tube F fits tightly into the lower arm of the cross piece. The gas enters through *b* into the cross piece, forces up the gauge *c* containing coloured water, and passes through the narrowed opening of the

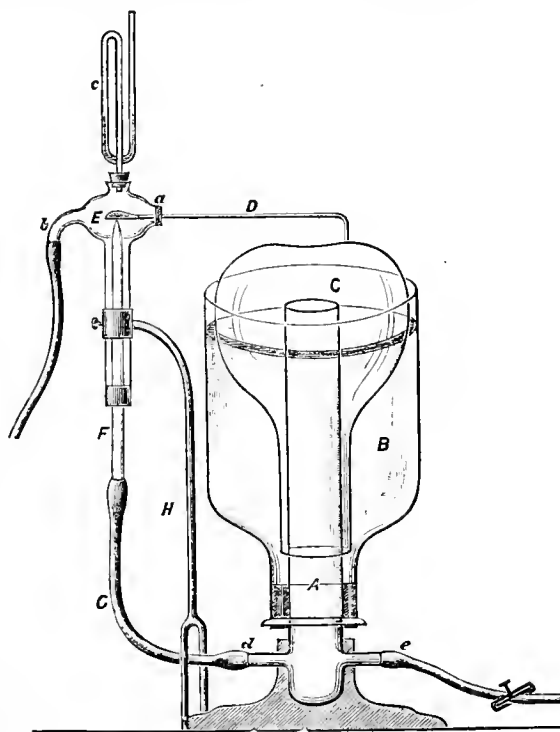


FIG. 1.

tube F, through the tubing G and *d* into A, where it fills the flask C and then by *e* to the burner. H is a brass stand for clamping the cross piece in position. The regulator should be supplied from an ordinary gas tap, and as this will deliver more gas than is utilised, the pinch cork is used to regulate the delivery.

The apparatus is so arranged that at the ordinary daily pressure the valve is $\frac{1}{2}$ mm. distant from the upper opening of the tube F, while the longer arm of the lever just touches the flask. To prevent accumulation of mould in the flask the author adds $\frac{1}{2}$ per cent. of phenol and acidifies the solution.

Fig. 2 represents a regulator devised by Giroud, and found very practical for general purposes. The construction and working of the apparatus may be readily understood from the diagram. When the tap is closed

the apparatus forms an ordinary regulator. For higher temperatures the tap is opened more or less. For lower temperatures the opening in the bell is partly closed

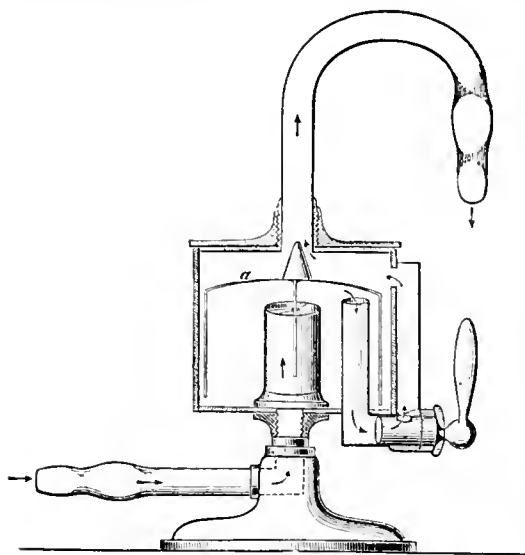


FIG. 2

with stearic acid. It is not advisable to screw a lamp directly on to the regulator, as the latter thereby becomes heated and no longer acts—J. B. C.

Estimation of Phosphoric Acid. J. Laubheimer. Chem. Zeit. 9, 1870.

THIS method, which is simple and rapid in execution, may be employed in all cases where hitherto it has been necessary to use the Molybdic method, the results being as accurate as those obtained with the latter method. For this purpose 25 or 50cc. of the phosphoric acid solution (containing from 0.1 to 0.2 grm. P_2O_5) are treated with 10cc. of citric acid (500 grms. per litre). Ammonia is then added in large excess, and the cold mixture treated with 15 to 20cc. of the usual magnesia mixture. A crystalline precipitate is produced, the separation of which is facilitated by stirring with a glass rod for one or two minutes. After standing all night the precipitate is thrown on a filter, washed with ammoniacal water, and finally with alcohol. It is then ignited in a platinum crucible and weighed. Phosphates rich in iron—e.g., Thomas' slag—require the use of a larger amount of citric acid and ammonia. Fassbender, of the experimental station of Kempen, has estimated the phosphoric acid in a variety of manures by this method, and compared the results with those obtained by the Molybdic method. The figures agree very closely.—D. B.

Notes on the Estimation of Iron and Aluminium in the Presence of Phosphoric Acid. M. Kretschmar. Chem. Zeit. 9, 1905.

THIS paper is a supplement to a former article (*Chem. Zeit.* 9, 942), in which the author described an indirect method for the estimation of iron and aluminium in superphosphates. He now points out that the determination of iron is very important, recent investigations having shown that the "going back" of phosphoric acid is chiefly due to the amount of iron, and less to the percentage of aluminium, in a phosphate. All direct methods for separating iron and aluminium are very tedious operations; the indirect process is more expeditious and very exact. If, however, a direct estimation be desired, it is best to precipitate iron and aluminium phosphate, and after determining their weight, to fuse the precipitate with potassium hydrate in a silver crucible.—S. H.

New Method for the Estimation of Phosphorus in Pig Iron and Steel. W. Kulmann. Monatsh. Chem. 6, 818.

ACCORDING to the quantity of phosphorus present, one to ten grammes of ore are fused cautiously with once or twice their weight of a mixture of two parts of calcined magnesia and one part of $KNaCO_3$ in a platinum crucible over the flame of a Bunsen's burner for one hour, stirring every ten minutes. After cooling, the melt is dissolved, and to its solution whilst being warmed, is gradually added sufficient citric acid to manifest an acid reaction. The liquid is then filtered, and the residue washed first by decantation, then upon the filter, with a one per cent. citric acid solution, until the filtrate with NH_4Cl and NH_4OH does not give any turbidity upon standing. To the filtrate is added NH_4Cl , and then about one-quarter its volume of strong ammonia, in order to precipitate the ammonium magnesium phosphate. When this precipitate has settled, it is filtered carefully and then dissolved in HCl and precipitated again with ammonia. After standing $1\frac{1}{2}$ to 2 hours it is filtered, and then treated in the usual way.—J. H. H.

A Simplification of the Molybdenum Method for the Estimation of Phosphorus. M. A. von Reis. Rep. Anal. Chem. 5, 381.

THE following rapid method gives good results:—Five grms. steel raspings are covered with 80cc. HNO_3 of sp. gr. 1.20. The whole is left thus for half-an-hour at about $100^\circ C.$, the vessel standing on a plate heated with steam. Then mixed with 50cc. of ammonium nitrate solution (seventy-five per cent.) and 10cc. NH_4OH of sp. gr. 0.91, precipitated with 50cc. molybdenum solution; digested and well stirred for one hour at $80-90^\circ C.$ The precipitate is washed with a solution of 150grms. NH_4NO_3 and 50cc. HNO_3 in one litre of water, and then dissolved in concentrated, and washed with dilute ammonia. It is then mixed with 10cc. of a ten per cent. ammonium chloride solution, precipitated with 5cc. magnesia mixture, let stand two hours, filtered, washed with 2–5 per cent. ammonia solution, the filter dried with the precipitate in a porcelain crucible in the air-bath, heated to a clear red heat for twenty minutes in the furnace, and weighed. Instead of this final precipitation with magnesia mixture, the author proposes to reduce the molybdic acid to the brown oxide, M_2O_3 , with zinc and acid, and then to titrate back to the molybdic acid with permanganate, and he gives full details of his process. (*Chem. Zeit.* 9, 852; and this Journal, iv. 179, 524; iii. 141, etc.)—J. H. H.

Detection of Mineral Oil and Resin Oil in Fat Oils. Oleins, etc. Focke. Rep. Anal. Chem. 5, 349.

ABOUT 20grms. of the sample are saponified on the water-bath with 8–10grms. of caustic potash and 50cc. of alcohol; the latter is evaporated, the soap is dissolved in water, the solution precipitated with hydrochloric acid, and allowed to cool when the stratum of separated fatty acids has become clear. The dilute acid solution is poured off, and the fatty acids are washed with water until the washings no longer exhibit an acid reaction. If necessary, the wash-water is filtered from any separated particles of fatty acids. The fatty acids (with any hydrocarbons present) are dissolved in ether, and the filtered solution is evaporated or distilled. The residue is weighed at intervals, the weight being considered constant when, after 15 minutes' drying, the diminution is only in centigrammes. To the solution of about 10grms. of fatty acids in 50cc. of alcohol are added some phenolphthalein, slight excess of caustic soda (1:3), and then, quickly, 100cc. of petroleum ether, which has been freed by distillation from hydrocarbons boiling above 100° . The mixture is now vigorously shaken, allowed to separate, then mixed with 500cc. of water gently turned and shaken, and finally placed on one side (should the alcoholic soap solution be "set" before the addition of the petroleum ether, it must be caused to liquefy by gentle warming). The aqueous soap solution

is poured off, after complete clearing, and the petroleum ether solution is again treated with 300cc. of water. When the greater part of the watery solution has been removed with a syphon, 10cc. of alcohol are added in a thin stream to the incompletely clear ethereal solution. Ten minutes later, the mixture is transferred to a separating funnel. The 80–85cc. of clear petroleum ether solution are evaporated in a large deep watch-glass. The percentage of neutral fats may also be estimated by titrating the fatty acids in the original substance, deducting this result from that obtained by the titration of the separated fatty acids, and dividing the difference by 95, as the oil used by manufacturers for oiling the wool contains on an average 95 per cent. of fat acids.

—E. G. C.

Examination of Commercial Glycerine. H. L. Sulman and E. E. Berry. *Analyst*, 11, 12–15 and 34–38.

THE published figures of the specific gravity of glycerine vary greatly, but are usually between 1.260 and 1.270. The authors have adopted Lenz's figure, 1.2675 at 15° C., as the most accurate, the lower results of other chemists being attributed to the great difficulty in concentrating glycerine completely without decomposing it. The approximate percentage of water in aqueous glycerine may be calculated from the formula—

$$\frac{1267.5 - 1000 D}{2.675 D}$$

where D is the observed specific gravity.

Neither the colour nor the specific gravity of a sample are safe indications as to whether it consists of crude or of distilled glycerine; as a rule, the latter is light in colour and rarely exceeds 1.261 in gravity, whereas the former is usually dark, and its gravity may be as high as 1.360.

To make certain of what the sample consists it must be ignited, as the amount of mineral residue in distilled glycerine is *never* more than 0.2 per cent., whereas *all* samples of crude contain much more, usually 9–14 per cent. in glycerines made from soap leys, though not so much in those from candle factories.

Organic Impurities.—Crude glycerine always contains albuminous matter, and usually resins (if from soap leys); the latter give rise to rosin oil in the distilled glycerine, in which it can be detected by agitating with ether, decanting and evaporating, when the rosin oil can be detected by its characteristic smell and taste. If crude glycerine (from soap leys) be acidified a white precipitate, consisting chiefly of resin and free sulphur, is obtained.

The traces of mineral matter in distilled glycerine may consist of sodium chloride, iron and copper. The chief organic impurities are formic, butyric and oleic acids, rosin oils, colouring and empyreumatic products, and occasionally organic sulphur compounds.

To determine the amount of *total mineral matter*, two portions of the sample must be ignited. As soon as the first has become completely charred it is taken up with water, filtered, and the sodium chloride determined in the filtrate by titration. The second portion is ignited until all the carbonaceous matter has been burnt off; the residue is then weighed, dissolved in water, and the amount of chloride in it ascertained. The difference of the sodium chloride determinations, added to the weight of the second ash, gives the total amount of mineral matter.

Chlorides cannot be determined directly in glycerine, since this dissolves an appreciable amount of silver chloride, and, if impure, reduces silver nitrate.

Crude glycerine usually contains 0.5 to 2 per cent. of alkali, generally as sodium carbonate, which can be determined by titration with standard acid, litmus being the best indicator.

Lime may be detected by adding to the glycerine an equal volume of alcohol containing 1 per cent. of sulphuric acid, or by the ordinary ammonium oxalate test.

The *total Organic Impurities* are determined by a modification of Champion and Pellet's process. The

glycerine is diluted with water, warmed with acetic acid to expel carbonic acid, an excess of basic lead acetate added, and the precipitate filtered off, dried, and weighed. It is then ignited with a little nitric acid, the residue weighed and deducted from the dried precipitate, when the amount of organic impurity is found. The object of the nitric acid is to prevent the reduction of any sulphate present. It is not accurate to ignite the above-dried precipitate with sulphuric acid, multiply the weight obtained by .736 and then deduct this from total weight, assuming the difference to be "organic impurities." In this process the sulphuric acid, of which some is usually present in crude glycerine, would be included in the organic matter. The amount of this latter should not exceed 0.5 to 1 per cent. in distilled glycerine.

Fatty Acids are detected by passing peroxide of nitrogen through the diluted glycerine, when a yellowish flocculent precipitate is thrown down.

Sugar may be detected by Mason's test, using 0.5cc. of the suspected glycerine, 15cc. water, 2 drops strong nitric acid, and 0.5 grammes of ammonium molybdate. On boiling for a short time a blue colouration is produced if 0.25 per cent. of sugar, glucose or dextrin (*not* lactose or arabin) be present. The liquid must not be highly coloured nor very acid.

Quantitative Estimation of Glycerine.—Dr. Flemming neutralises with acid, filters, adds milk of lime, and evaporates to dryness. The residue is completely exhausted with a mixture of alcohol and ether (3:1) and the solution evaporated, dried at 115° and the residue weighed. It is then ignited and the ash deducted from the previous weight. This process is not accurate, on account of the volatility of glycerine during concentration, and figures are quoted from a paper by Nessler and Barth, who conclude that the loss of glycerine depends on (1) the height of the walls of the vessels, (2) the conductivity of the heat of the same, and (3) the area of the exposed surface of the liquids.

Morawski's Method consists in slowly heating the glycerine with lead oxide to 120° to 130° till the weight is constant. A glyceride of lead ($\text{PbO.C}_3\text{H}_5\text{O}_2$) is formed, and the increase in weight of the lead oxide multiplied by the factor 1.2432 gives the percentage of glycerine in the sample. The results are very satisfactory, but the process cannot be used if mineral or organic impurities are present.

Attention is called to two misprints in the abstract of this process in the *Jour. Soc. Chem. Ind.* (vol. i. 75), where *peroxide* of lead is given instead of oxide, and the factor 1.3429 (which is also wrongly given in Morawski's original paper) instead of 1.2432. It was found that the long preliminary desiccation of several hours was not essential, and that a good result could be obtained by merely heating the mixture of lead oxide and glycerine to 120° to 130° C. for two hours, provided the mixture was covered with a thick layer of dry lead oxide.

Dr. Muter's Method (*Analyst*, vi. 41, and Allen's "Org. Commercial Analysis," vol. ii.) is preferred, but it is not available for crude glycerine unless it be previously treated with basic lead acetate (and the excess of lead afterwards precipitated), so as to remove the albuminous matter, which itself dissolves copper oxide in an alkaline solution.

J. Puls's Process is similar to Muter's, and he has shown that in solutions containing 1.85 to 5.80 per cent. of glycerine, 73.5 parts of CuO will always be dissolved by ninety-two parts of glycerine (one molecule) in the presence of ninety-four parts of potash (K_2O); this ratio of glycerine to copper oxide is *not* constant, however, beyond the above limits. Hence, in using Muter's method, the authors prefer to use for the check experiment a solution containing as nearly as possible the same proportion and same actual weight of glycerine as there is in the known volume taken of the filtrate obtained after purifying the crude glycerine sample by basic lead acetate.

Zsigmondy and Benedikt's Process consists in oxidising glycerine to oxalic acid by an alkaline permanganate solution and estimating the oxalate by precipitation

Ferric Oxide.—10grms. are required for 10cc. of wine. Erythrosin, acid magenta, Bordeaux red, and roccellin red, are not acted upon. All other fuchsin colours are extracted. The author considers that upon these preliminary results a general and reliable method may be eventually built up.—J. B. C.

Method for Estimating Tannin. F. Jean. Bull. Soc. Chim. 1885, 44 183.

A CIRCULAR piece of paper .05 in diameter is laid upon a piece of black cloth about 20cm. square, and placed near a well-lighted window. Upon this a beaker is placed of 800cc. cap. and .085 inside diam., a volume of 200cc. being indicated by a mark. 5cc. of Fe_2Cl_6 solution are run into the beaker (the solution contains 14grms. Fe_2Cl_6 and 10cc. HCl in the litre) and to this 1 p.c. solution of tannin is added drop by drop. After each addition the liquid is quickly agitated with a glass rod, and observed as soon as the circular movement begins to cease. The operation is finished as soon as the white spot has become completely invisible, which occurs on the addition of 11.6cc. of tannin solution. It is therefore a very simple matter to estimate tannin in this way. It is only necessary to take the precaution of having the tannin solution to be tested of approximately 0.1 per cent. strength, and this is attained by using the following quantities with 100cc. of water: 1.5grm. European oak bark, 1grm. African bark, .5–6grm. Quebracho, .4–5grm. sumach, .25grm. catechu. The method allows of a determination to .5 per cent., and is completed in a few minutes. As gallic acid has not the same value for tanning as that precipitable by albumen, the analysis of this acid is of importance. A modification of the above process may be used. An aqueous extract of the raw material is made so that 100cc. water contain 2grms. of gallic acid. After diluting 50cc. to 100cc. with water, the quantity of Fe_2Cl_6 is determined necessary to produce complete opacity. In the remaining 50cc. 2grms. of scraped skin previously softened in water and dried between linen are added. After two hours the liquid is filtered through linen washed with water, 10cc. of 1 per cent. solution of pure tannin added, and diluted to 100cc. with water. This liquid contains 1grm. tannin and gallic acid, or other compounds not precipitable by tannin. The difference in volume of the 1 per cent. tannin solution and that of the solution to be determined gives the quantity of gallic acid.—J. B. C.

The Detection of Honey adulterated with Starch or Cane-sugar. H. Hager. Pharm. C. H. N. F. 1885, 6, 327.

THE following qualitative method has been proposed by the author:—

1. Starch-sugar or maize-starch syrup. 1–2cc. of 25 per cent. clear filtered honey solution are introduced into a test glass, and covered then carefully with about 5cc. absolute alcohol. With pure honey, the alcohol layer remains clear; with honey containing starch-sugar, or maize-starch syrup, the contact layer becomes milky white and retains this milkiness.

2. Cane-sugar or beetroot-sugar. 1.5 to 2cc. of concentrated sulphuric acid are introduced into a test glass 1cm. wide, and this is covered with 5cc. of a solution containing 25 per cent. of honey. The honey solution is not coloured at once at the layer of contact, and within an hour, yellow or light brown. In the presence of cane-sugar the contact layer is coloured brown at once, and after an hour almost black.—J. B. C.

The Iodine Test for Peppermint Oil. G. Koll. Pharm. C. H. F. 1885, 6, 467.

IN the German pharmacopœia II. it is stated, that by moistening powdered iodine with peppermint oil, there should be no rise of temperature. The author has tested different kinds of peppermint oil and found that with ol. menth. ppt. gallicum the temperature rose to 41°, with mitcham oil to 44°, and with German oils to as much as 54°. The clause would therefore read more correctly

thus:—that "In contact with iodine no strong heating or violent reaction should occur."—J. B. C.

Estimation of Oils which contain Unsaponifiable Fats. Th. Morawski and H. Demski. Dingl. Polyt. J. 258, 39.

COMPLETE separation of the liquid layers obtained by treating the saponified liquid with volatile solvents is often a matter of difficulty. 10grms. of the oil are treated with 50cc. of alcohol, and 5grms. KOH dissolved in the smallest quantity of water added, and the whole heated for half-an-hour with inverted condenser, 50cc. of water are added, and the mass allowed to cool. It is then shaken in a separating funnel with petroleum ether, and after the liquids have separated, the under-layer is removed, the petroleum layer is repeatedly washed with water, the washings being kept apart and separated as completely as possible from the ether. Instead of allowing the ether to run directly into the weighing bottle, it is first drawn off into a dry flask. If now the ether is transferred to the tared bottle, any drops of water will remain behind. The liquid, which has been once treated with ether, is again extracted in the same way, and the ether transferred to the weighing flask. To detect quickly if the nonsaponified fat is resin or mineral oil, it is shaken with an equal volume of acetone. If both liquids mix completely, it is a resin oil, or a mixture with a small proportion of mineral oil; if not, it is a mineral oil or a mixture with a small quantity of resin oil. Alcohol of sp. gr. .95 may be used, in which resin oils sink, whereas mineral oils do not. The determination of the vegetable oil present in the mixture with the mineral or resin oil can either be effected in the original mixture (by iodine and saponification) or with the fatty acids, which after separating the nonsaponifiable fat, are precipitated with an acid. This experiment may be extended to the saponification value, the melting and freezing point and the determination by iodine, according to Hübl's method. By the latter method the iodine, for the free fatty acid, must be first determined, as Hübl only determined it for neutral fats. For these determinations it is only necessary to act directly on the fatty acids with Hübl's iodine solution. If it is required to calculate the iodine amount I of the saponifiable fat from the amount I_2 of the original mixture of the separated nonsaponifiable fats and I_1 of the mixture, this may be done by the following equation: $I = (100I_1 - bI_2) : a$, in which a is the percentage of saponifiable and b that of the unsaponifiable fats. The first method is, however, to be preferred.—J. B. C.

Determination of Nitrogen in Organic Substances by Kjeldahl's Method.

THE method of Kjeldahl, published in detail in *Zeits. Anal. Chem.* 22, 366, is as follows:—

About one gramme of substance is placed in 100cc. flask, and 10cc. of strong H_2SO_4 , together with P_2O_5 added, and the mass then heated on wire gauze just below its boiling point until the original dark mass changes to a light yellow or colourless solution. Powdered KMnO_4 is then added in small portions at a time, but rapidly. It is advisable to sift it into the flask through a sieve of wire gauze. The oxidation is complete when a green colour appears. The mass is then warmed gently over the flame for 5–10 minutes, and after cooling transferred to a distilling flask of three-quarters litre capacity, to which a bent tube and condenser is attached, and an Erlenmeyer flask of one-quarter litre capacity placed as receiver, containing 10–40cc. of standard HCl solution. An excess of caustic soda of sp. gr. 1.3 is introduced, and the ammonia distilled off and determined in the receiver by titration. Slight modifications of this method have been recommended by various chemists. Wilfarth (*Chem. Centr.* 16, 17) uses a mixture of eight parts cone. H_2SO_4 , two parts fuming H_2SO_4 , and one part P_2O_5 ; he also adds .5 to 1grm. $\text{CuSO}_4 + \text{H}_2\text{O}$ or H_2O .

Pfeiffer and Lehman (*Zeits. Anal. Chem.* **24**, 388—393) modify the distilling apparatus so as to prevent any of the alkaline liquid being carried over, by interposing between the flask and the receiver an arrangement shown in the annexed figure, *c* being a perforated platinum cone surmounted by glass beads.

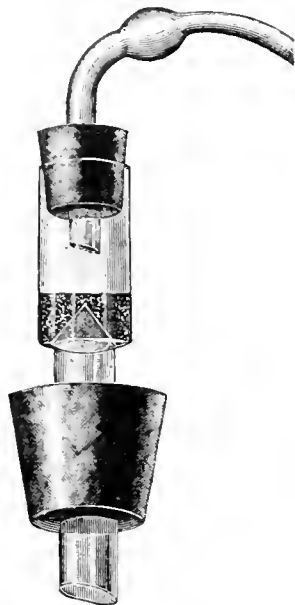


FIG. 1.

The above method has been the subject of a critical examination by Märcker and his assistants (*Zeits. Anal. Chem.* **23**, 553—557), who have analysed sixty-five different substances, and compared the results with those obtained by the method of Will and Varrentrap. The average difference amounts to 0.84 per cent., the higher result being obtained in the majority of cases by Kjeldahl's method.



FIG. 2.

The following are the advantages attributed by the authors to the latter method:—

1. It is less expensive, and there is a considerable saving in time, as a large number of determinations may be simultaneously carried out without close attention.
2. It is not requisite that the substance should be finely pulverised, and liquids may be quite as readily analysed as solids.
3. The distillate in the final operation is colourless, and therefore rosolic acid may be used and the titration carried on by gaslight.

For ordinary organic substances not more than one gramme should be taken; for manures 1.5 grm.

The authors supplement their results with the following modifications, which they recommend:—

The substance is covered with 20cc. of a mixture of four volumes concentrated pure H_2SO_4 , one volume fuming H_2SO_4 , and then two grammes of P_2O_5 are added. The mass is at first heated with a small flame to prevent frothing, which occasionally occurs with fat-foods. The mass is then well boiled, a process which the authors consider indispensable, and not as Kjeldahl recommends. The boiling is continued until the liquid attains a Rhine wine colour; or, at most, a faint red. The time required varies from half-an-hour, in the case of manures, to two hours, for foods; and 4—5 hours for blood, etc. The amount of NaOH recommended is such that after neutralising the acid with NaOH solution of 50° B. about 15cc. remain in excess. In washing the liquid into the distilling flask, an excess of water should be avoided. The amount of liquid should not exceed 200—250cc. By this means the whole of the NH_3 is driven over in half-an-hour. Where a number of determinations have to be performed simultaneously, the apparatus as shown in the diagram is employed.

Fig. 2 shows the apparatus in which the first portion of the operation is carried on, and consists of an iron tray with seven holes, in which the flasks containing the substance and sulphuric acid mixture are heated. Fig. 3 represents an iron stand provided with holes, upon which the flasks protected from the flame by wire gauze are placed. The condenser is an oblong box of tinned iron. Bohemian is used in preference to ordinary glass, as the alkali in the former is not dissolved by steam.—J. B. C.

Ammonia as a Reagent for Double Ketones which have the structure $CO : CO = 1 : 4$. Ludwig Knorr. *Ber.* **19**, 46—49.

THE author has shown (*Ber.* **17**, 2869; **18**, 300, 1558) that ammonia and primary amines act on diaecosuccinic ether with formation of pyrrol derivatives. Paal (*Ber.* **18**, 367, 2251) and Ledner and Paal (*Ber.* **18**, 2591) have observed that ammonia reacts similarly with acetophenone-acetone, acetylacetone, and acetophenone-

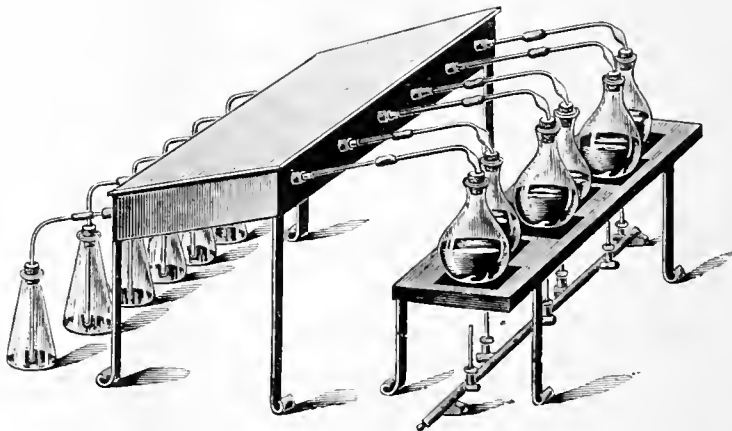


FIG. 3.

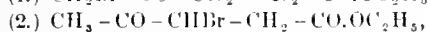
acetic ether. The reaction, therefore, appears to be a general one for double ketones of the formula—



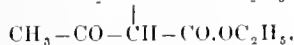
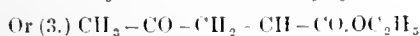
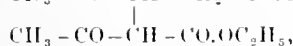
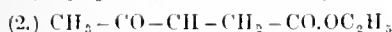
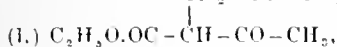
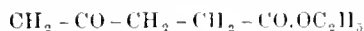
The pyrrol derivatives so formed, when boiled with a dilute mineral acid, colour a pine shaving a deep red, and the reaction is so delicate that the merest trace of the pyrrol derivative, even in presence of other bodies, may be detected by it. Since also the double ketones, which have the structure $CO : CO = 1 : 4$, are readily converted by ammonia into pyrrol derivatives, such ketones

may be at once detected by this reaction. The ketone is dissolved in glacial acetic acid, and is boiled with a solution of ammonia in excess of acetic acid; the mixture is then boiled with dilute sulphuric acid, and the pine shaving introduced. The author succeeded in detecting the presence of 1mgm. of diaceto-succinic ether in a solution of 1 : 5000.

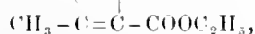
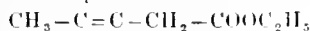
The value of the reaction in determining the constitution of compounds is shown by the following instance :—Bromo-levulinic ether may be represented by either of the three structural formulæ—



By the action of sodaceto-acetic ether one of the three following bodies must be formed :—



The compound formed shows the above-mentioned reaction, and must, therefore, be represented by the formula 1 or 2. But the first appears improbable when the action of the halogen elements on aceto-acetic ether is taken into account, and the author, therefore, adopts the second formula as correct, and names the condensation product α - β -diaceto-glutaric ether. The ether boils between 240° and 250° under a pressure of 140mm., with partial decomposition. By the action of ammonia and excess of acetic acid, after boiling a few minutes, dimethylpyrrolecarboxyl-acetic ether—



is obtained in the form of lustrous scales melting at 109–110°. The acid was also prepared from the ether by saponification with dilute caustic soda. It melts at 196° with rapid evolution of carbonic anhydride, the residual oil being probably trimethylpyrrol. The ether, the acid, and the pyrrol all show the reaction with pine shavings.

—S. Y.

New Books.

LESSONS IN ELEMENTARY CHEMISTRY—INORGANIC AND ORGANIC. By Sir HENRY E. ROSCOE, LL.D., F.R.S. New Edition. London: Macmillan & Co., 1886.

No description of this well-known work is required: suffice it to say, that whilst preserving carefully the concise form and treatment so necessary in a book to be used in schools as well as in the colleges, certain important additions have been made by the author in reference to new facts brought to light since the last reprint in 1877.

ORGANISCHE FARBSTOFFE. Von Dr. R. NIETZKI. Breslau: Verlag von Edward Trewendt, 1886. London: H. Grevel, 33, King Street, Covent Garden.

SMALL OCTAVO volume, bound in cloth, price 4s. (4 Mark). The work treats both of the natural and artificial colouring matters with great conciseness, but with copious references to original sources. The mode of treatment is gleaned from the arrangement

of the subject-matter in the table of contents (Inhaltsverzeichnis), of which the following is an outline :—

(A) NATURAL DYES AND COLOURS: (B) DYES AND COLOURS ARTIFICIALLY PREPARED.—I. Nitro-compounds. II. Azo-colours—(1) *Amidoazo-compounds*; (2) *Oxyazo-compounds*; (3) *Tetraazo-colours* or *Disazo-compounds*. III. Colours of the Triphenylmethane Series—(1) *Diamidotriphenylmethane colours*; (2) *Triamidotriphenylmethane colours*; (3) *Rosolic acid colours*; (4) *Phthalic acid colours*. IV. Indamines and Indophenoles. V. Safranines and Allied Dye-stuffs. VI. Aniline Black. VII. Indulines and Nigrosines. VIII. Quinoline and Acridine Colours. IX. Anthraquinone Colours.

Monthly Patent List.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

1886.

2661 J. Dawson, Bury. Improvements in steam blowers for producing air draught in furnaces, and for other purposes. February 24

2721 R. de Soldenhoff, London. Improvements in furnaces for the desiccation, incineration, and carbonisation of precipitants or solids resulting from sludge or other substances liable to putrefy, as also for the treatment of coal or carbonaceous substances. Complete specification. February 24

2739 J. Merritt, Birmingham. Improvements in the construction of pumps for vinegar and other acid liquids. February 25

2861 F. Windhausen, Halifax. Improvements in apparatus for refrigerating purposes. February 27

2875 A. Milne, J. F. Gray, and A. S. Tomkins, London. An improvement in smoke consuming apparatus. February 27

2927 H. E. Newton, London—Communicated by E. Theisen, Germany. Improvements in apparatus for cooling and condensing purposes. March 1

2962 J. A. Muller, London. Improvements in apparatus for measuring and registering currents of water or other liquids, and also fluids or gases. March 2

2973 W. R. Lake, London—Communicated by W. O. Webber, United States. Improvements in centrifugal pumps. March 2

2992 J. Newton, Longport. Improvements in pipes and taps for filter presses. March 3

3020 W. Beesley and J. Beesley, London. Improvements in steam-boilers applicable for utilising the waste heat from puddling, forge, mill, or other furnaces. March 3

3023 J. Murrie, Glasgow. Improvements in apparatus for indicating temperature or pressure. March 3

3099 R. McLaren Young, London. Improvements in steam-boiler and other furnaces. March 4

3134 J. Howarth, Manchester. Improvements in apparatus for cooling, warming, moistening, or saturating air. Complete specification. March 5

3150 J. B. Alliot and G. P. Haughton, London. Improvements in or connected with centrifugal drying machines. Complete specification. March 6

3266 H. Callas, London. Improvements in fuel supports for steam boiler furnaces. March 9

3270 C. S. Madan, Manchester. Improvements in injectors for raising and forcing fluids and feeding steam boilers. March 9

3287 W. R. M. Thomson, Glasgow—Communicated by O. Coldewe, Germany. Improvements in smoke-consuming furnaces. March 9

3300 J. H. Campbell, London. Improvements in method of and apparatus for utilising binary liquids, more especially aqua ammonia, as a motive power. Complete specification. March 9

3326 A. M. Clark, London—Communicated by P. Oriollo, France. Improvements in, and in apparatus for, distilling water. March 9

3393 J. Lysaght and J. Lysaght, Limited, London. Annealing apparatus. March 10

3442 G. H. Moore, Liverpool. Methods of and apparatus for refining fluids. Complete specification. March 11

3581 H. McDowell, London. Improvements in appliances for consuming smoke in boilers, furnaces, and the like. March 13

3587 J. R. Alsing, London. Improved mode of triturating and apparatus for such purpose. Complete specification. March 18

3589 H. E. Newton, London—Communicated by R. A. Chesebrough, United States. Improvements in hot-air furnaces. Complete specification. March 18

3597 W. Sellar, London. Improvements in apparatus for heating, purifying, and filtering water used for feeding steam

boilers; also applicable for filtering the feed water for pumps, or suction pipes in sinking pits, wells, dry docks, and the like; and for filtering water generally. March 19
 3964 G. P. Keldern, London—Communicated by C. A. Johansson, Sweden. An improved centrifugal separating machine. Complete specification. March 20
 4013 C. Little, Chesterfield. Improvements in pumps and air compressors. March 22

COMPLETE SPECIFICATIONS ACCEPTED.*

1885.

3896 J. H. Johnson—Communicated by M. Perret. Improvements in furnaces for burning pulverulent materials; applicable also to gas producers. March 12
 3654 H. J. Haddan—Communicated by A. Liedbeck. Distilling apparatus. March 5
 5816 F. J. Austin and S. Low, jun. Prevention of formation of boiler crust. March 12
 6276 C. C. Carpenter. Retort lid fittings. March 23
 7389 W. P. Thompson—Communicated by F. C. Glaser. Apparatus for separation of suspended matters from water, etc., and removal of the resultant sediment. March 12
 13466 E. Solvay. Apparatus and process for producing, applying and keeping up extreme temperatures. March 9

1886.

266 R. Wainwright and W. Wainwright. Construction of furnaces for effecting the consumption of smoke. March 19
 703 L. T. Karras. Apparatus for lifting or handling crucibles, etc. March 5
 1436 H. Kosiecke. Smoke-consuming furnaces. March 2
 1517 J. S. Badia. Automatic apparatus for generating gases. March 19
 2252 L. Douillet. Metallic casks or drums. March 16

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

2618 C. Blagburn, London. Improvements in the method of and apparatus for injecting petroleum and other liquid fuel into furnaces. February 23
 2751 J. C. Stitt, Liverpool. Improvements in connection with the combustion of fuel in furnaces of steam generators and in the furnaces employed therein. February 25
 2766 W. L. Wise, London—Communicated by F. J. Lothamer, France. Improved portable apparatus for the manufacture of gas. February 25
 2803 J. Lilley, London. Improvements in apparatus for the manufacture of artificial fuel. February 26
 2807 S. W. Allen and G. Breditt, London. Improvements in apparatus for the manufacture of artificial fuel. February 26
 2836 R. C. Sinclair and S. W. Snowden, London. Improvements in means for effecting the consumption of smoke, and economy of fuel from and in the furnaces or fireboxes of locomotive steam-engines and the like. February 26
 2892 H. Bowater, Cradley. The purification of coal gas. March 1
 2904 F. J. Jones, London. Improvements in gas producers, whereby the whole of the combustible elements in the original coal, etc., are converted into permanent gases. March 1
 2950 J. Parkes, Birmingham. Improvements in apparatus for enriching illuminating gas. Complete specification. March 2
 3057 J. A. Yeadon and R. Middleton, Leeds. Improvements in machinery or apparatus for the manufacture of artificial fuel or other materials. March 4
 3058 J. A. Yeadon and R. Middleton, Leeds. Improvements in machinery for the manufacture of artificial fuel or other similar materials. March 4
 3074 W. Smith, London. A simple way of burning hydrocarbons in a furnace after the manner of a coal fire. March 4
 3320 H. H. Salomons, London. Improvements in means for securing the lids or covers to the mouthpieces of gas retorts. March 9
 3381 J. A. Yeadon and R. Middleton, Leeds. Improvements in machinery for the manufacture of artificial fuel or other similar materials. March 13
 3392 O. Imray, London—Communicated by C. A. von Welsbach, Austria. Improvements in illuminant appliances for burners. March 13
 3697 F. Windham, London. An improvement in the manufacture of gas for use in gas-engines. March 16
 3767 J. H. W. Stringfellow, London. Improvements in the method of and apparatus for burning hydrocarbon and other oils. March 17
 3771 W. Edwards, London. A new or improved mode of and means for the manufacture and utilisation of gas from hydrocarbons. March 17
 3796 G. Parkes, Birmingham—Partly communicated by A. Parkes, United States. Improvements in producing heat and light for cooking, lighting, and other purposes. March 18
 3883 W. Grierson, Glasgow. Improvements in electrostatic induction machines for lighting gas, applicable also for other electrical purposes. March 19

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Specifications thus advertised are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

2986 J. G. Lorrain. Improvements in lighting. March 5
 4798 S. Butler. Manufacture of artificial fuel, and machinery therefor. March 9
 5399 P. Tarbutt. Apparatus for combustion of liquid hydrocarbons. March 2
 5980 A. Wilson. Gas producers. March 23
 6881 J. Y. Johnson—Communicated by La Société Anonyme des Forges et Chantiers de la Méditerranée. Apparatus for manufacturing blocks of artificial fuel. March 23
 12540 H. M. Morrison—Communicated by J. G. Hathaway. Apparatus for pulverising fuel and feeding it to furnaces, etc. March 23
 15367 G. Anderson. Apparatus for distribution of gas and air in regenerative and other furnaces wherein gaseous fuel is used. March 16

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, ETC.

APPLICATIONS.

3495 L. M. Becker, London. An improved method of treating hydrocarbon oils and petroleum residuums. March 12
 5738 G. T. Beilby and J. B. McArthur, St. Kitts, N.B. Utilisation of waste hydrocarbons. March 17

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

10438 H. J. Haddan—Communicated by J. Quaglio. Apparatus for compressing coal, and introducing the same into coke ovens. March 16

1886.

1016 H. Kenyon. Distillation and decomposition of coal, shale, etc., to obtain illuminating gas and other matters. March 9
 1017 H. Kenyon. Ovens or retorts, etc., for use in distillation of coal, shale, etc. March 2

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

2878 A. M. Clark, London—Communicated by A. Muller-Jacobs, through Wirth & Co., Germany. Improvements in the manufacture of colouring matters and vehicle therefor. February 27
 3198 J. Y. Johnson, London—Communicated by The Actien-gesellschaft Farbenfabriken vormals F. Bayer & Co., Germany. Improvements in the manufacture of azo dyes and benzidine and tolidine mono-sulpho acids. March 6
 3247 M. B. Vogel, London. Processes for producing oxalates of antimony suitable as mordants in dyeing and printing. March 8
 3407 J. Y. Johnson, London—Communicated by The Farben-fabriken vormals F. Bayer & Co., Germany. Improvements in the manufacture of dyes. March 10
 3552 J. B. Cohen, Manchester. Improvements in or appertaining to the separation of the amines or organic bases. March 13
 3890 T. Carnelley, Dundee. The preparation of para-amido-diphenyl sulphonic acid. March 19

COMPLETE SPECIFICATION ACCEPTED.

1886.

2083 W. R. Lake—Communicated by A. E. Spencer. Blueing for laundry purposes, and means for use of the same. March 12

V.—TEXTILES: COTTON, WOOL, SILK, ETC.

APPLICATIONS.

2616 H. J. Haddan, London—Communicated by the United States Waterproofing Fibre Co., Limited, United States. Improvements in the method of and composition for treating textile fabrics, cordage, ropes, nets, and similar materials. Complete specification. February 23
 2656 O. W. G. Briegleb, London—Communicated by Dr. J. F. Riep, Holland. Improvements in the treatment of ricea and other fibres. February 23
 2660 K. T. Sutherland, Manchester. An improved material for sizing yarn and for finishing piece goods. February 24
 2805 W. Pollitt, Chichester, Yorks.; A. Stevenson, Osssett, Yorks.; and J. Priestley, Sandal, Yorks. A new means of treating waste fibrous substances, and utilising the whole or portions thereof. February 26
 2817 G. W. Hargreaves Brogden and E. Casper, London—Communicated by E. Frémy and Y. Urbain, France. Improvements in obtaining and treating fibres from the backs of plants of the Urtica family and the like. February 26
 3065 R. W. Thom, Manchester. Improvements in finishing textile fabrics and in apparatus therefor. March 4

- 3095 G. F. Redfern, London.—Communicated by E. Chevallot, France. Improvements in waterproofing fabrics. March 4
 3098 W. H. Murray and R. J. Young, London. A solution rendering textile fabrics and other materials both fire-proof and water-proof. March 4
 3483 G. Lendrum and D. F. Cocks, Huddersfield. A new or improved treatment or "finish" of stockinette fabrics. March 12
 3532 J. Hibbert, Halifax. Improvements in apparatus for controlling and regulating the flow and supply of size to and from boiling pans of machines employed for sizing yarns. March 12
 3555 A. B. O'Connor and J. H. Wilson, London. Improvements in apparatus and method of treating wool and other similar substances for the purpose of cleansing, extracting, and recovering the fats and other products therefrom. March 13
 3755 W. S. Johanson, Liverpool. Improvements in the manufacture or softening of linen, hemp, jute, or other yarns. March 17
 3880 H. Rouse, Bradford. A new fabric for dress goods and other clothing purposes. March 19
 3937 H. Birkbeck, London.—Communicated by T. F. Peppé, India. Improvements in treating and preparing "Tussur" and other wild silk cocoons, and in the application of the silk obtained therefrom to the manufacture of lace, knitted warp, and other fabrics. March 20
 3980 F. Robinson, Leeds. An improved process in the manufacture of plush and other pile fabrics by the double cloth method. March 22

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 14393 M. Iwand and F. Kühne. Treating webs, wool rags, waste, etc., to be carbonated in the wet way; and drying the same. March 12

1886.

- 1896 W. R. Lake.—Communicated by H. R. Randall. Treatment of silk cocoons, raw silk, etc. March 9
 2206 H. H. Lake.—Communicated by F. G. Sargeant and A. C. Sargeant. Drying wool and other fibrous materials; and apparatus therefor. March 16
 2616 H. J. Haddon.—Communicated by the United States Waterproofing Fibre Co., Limited. Method and composition for treating textile fabrics, etc. March 23

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

- 3247 M. B. Vogel, London. Processes for producing oxalates of antimony suitable as mordants in dyeing and printing. March 8
 3248 M. B. Vogel, London. Improvements in mordanting vegetable fibres, yarns, and fabrics. March 8
 3732 H. Kershaw, Manchester. Improvements in dyeing textile goods and materials. March 17
 3744 T. Holliday, London. Improvements in dyeing wool and other textile animal fibres. March 17

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 6018 T. J. Hutchinson, Bury. Process and apparatus for treating greasy waste preparatory to bleaching. March 23
 6331 E. Taylor. Purifying and decolouring water in which silk and other fibrous materials have been boiled with soap, and the refuse, liquid or dye, in which silks, etc., have been dyed or cleansed; and recovering useful products therefrom. March 16
 6888 W. R. Lake.—Communicated by The Prag Smichower Kattun Manufactur and F. Storck. Apparatus for fixing colours printed on cotton fabrics, and for washing the same. March 23

1886.

- 1424 W. Birch. Apparatus for washing, soaping, dyeing and dunging woven fabrics. March 2

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

- 2739 J. Merritt, Birmingham. Improvements in the construction of pumps for vinegar and other acid liquids. Feb. 25
 2779 H. Whitehead, R. Hodgson, and W. H. Green, Longport. Improved apparatus for making boiled, common, and fishery salt from brine by steam. February 26
 3063 J. M. Walton, Manchester. Improvements in the manufacture of bisulphites from alkaline bases, and in apparatus employed in such manufacture. March 4
 3220 A. Dempster, Halifax. Improvements in apparatus for distilling ammoniacal liquor for the purpose of producing sulphate of ammonia. Complete specification. March 8
 3231 J. Gale, London. Improvements in apparatus for collecting and absorbing carbonic acid gas and other noxious gas or gases. March 8
 3238 L. Mond, Liverpool. Improvements in obtaining ammonia, chlorine, and hydrochloric acid from ammonium chloride. March 8

- 3322 B. J. B. Mills, London.—Communicated by The Verein für Chemische Industrie, Germany. An improved process of producing chlorine, and chlorine and ammonia. Complete specification. March 9

- 3371 J. Whittle, London. Improvements in and apparatus for the manufacture of acetic and other similar acids. March 10
 3406 E. F. Trachsel, London. An improved process for the production of carbonate of sodium, or of potassium and hydrate of strontium, or of barium. March 10
 3556 J. H. Johanson, London.—Communicated by E. Hermite, France. Improved means for producing ozone and hydrogen suitable for bleaching purposes. March 20
 3557 J. H. Johnson, London.—Communicated by E. Hermite, France. Improved means for producing chlorine compounds suitable for bleaching purposes. March 20

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 4136 C. Wigg. Apparatus for manufacture of carbonate of soda and caustic soda. March 5
 5260 J. Brock and W. A. Rowell. Manufacture of chromates and acid chromates. March 2
 5280 W. L. Wise.—Communicated by R. Radot. Decarbonation of various earthy carbonates; and apparatus therefor. March 12
 5620 C. Wigg. Utilising certain residuals from the manufacture of copper and alkali. March 12
 5919 J. F. Chance. Production of nitrate of ammonia and bicarbonate of soda. March 16
 5920 J. F. Chance. Purification of alkaline tank or vat liquors. March 16

1886.

- 2262 E. Luhmann and C. G. Ronneuhöller. Measuring apparatus for liquid carbonic acid. March 16

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

- 2799 A. W. Lake, London.—Communicated by T. Hyatt United States. Improvements in exfoliated or crystallised, glass, and in means, modes, and processes therefor. Feb. 26
 2855 H. S. Sant and S. Sant, Longton. A new process for the decoration, mosaic or otherwise, of all kinds of pottery-ware, by the use of skeletons or fibres of leaves or other parts of plants, trees, or vegetables, or of insects, or anything capable of being skeletonised. February 27
 3096 G. F. Redfern, London.—Communicated by A. V. Morizot, France. An improved process for colouring ceramic products whilst in a cold state. March 4
 3252 A. C. Henderson, London.—Communicated by L. Charmanier and S. de Cazenave, France. Improvements in the manufacture of stained glass windows, the said invention being also applicable to the decoration of other articles of glass or crystal. March 8
 3369 J. D. Denny, Ruabon. An improvement in embossed and geometrical tiles, also mosaics, and appliances for making the same. March 10
 3391 T. J. Payne, Romford. An improvement in the manufacture of fire-bricks, retorts, crucibles, and other fire-ware goods. March 10
 3393 J. Lysaght and J. Lysaght, Limited, London. Annealing apparatus. March 10
 3419 W. Cartledge and H. Cartledge, Liverpool. Improvements in enamel, lustre, and hardening kilns used in the manufacture of pottery-ware. March 11
 3420 G. A. Jarvis, Wellington, Salop. Manufacture of improved basic bricks
 3421 G. A. Jarvis. Improvements in the manufacture of basic bricks. March 11
 3419 C. E. Davis, London. Improvements in tiles for roofing. March 11
 3567 T. Stanway and F. Spencer, Longport. An improved method of testing the heat of "enamel" and other similar kilns. March 13
 3618 J. Critchlow, London. An improved mode or method of hydraulic filter-press for the production of potters' clay and other purposes. March 15
 3372 W. E. Chance, London. New or improved machinery for the manufacture of sheets of rippled glass. March 20

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 5175 W. M. Brown and H. Clayton, Halifax. Fireclay, earthenware, or stoneware baths. February 26
 6463 J. G. Sowerby. Construction of moulds for manufacture of glass-ware. March 5
 6337 J. G. Sowerby. Moulds for articles of glass or other ware. March 2

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

- 2659 C. Spackman, Sibley, Loughborough. An improved system of drying the prepared mixture of raw materials for the manufacture of Portland cement. Complete specification. February 24
 3102 T. Weekes, London. Improvements in the manufacture of Portland cement. March 4

- 3171 J. Prince and W. Johnson, Leeds. Improvements in the mode of treating, mixing, and cleaning clays and other materials, and in machinery employed therefor. March 6
- 3217 J. B. Hannay, Glasgow. Improvements in treating sewage and making cement. March 8
- 3462 S. Collier, jun., London. Improvements in disintegrating or pulverising machines for the manufacture of lime and cement. March 11
- 3832 W. E. Constable, London. Improvements in the manufacture of artificial asphalt. March 18
- 3909 H. Peters, Rochester. Improvements in the manufacture of Portland cement. (Previously included in No. 447, of 1886.) January 11
- 3961 S. Frankenberg, London. An improved cement or composition for use in laying or fixing wood and other pavements and blocks for mosaic work and the like. March 20

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 6133 E. Cammiss. Means and apparatus for manufacture of bricks. March 2
- 6441 C. F. Foster. Paving of streets, etc., and manufacture of blocks therefor. March 23
- 13840 T. Hunter and J. G. Brown. Making and setting (in water) cement concrete blocks. March 2

1886.

- 1604 E. Ashby and A. Ashby. Cement kilns. March 9

X.—METALLURGY, MINING, Etc.

APPLICATIONS.

- 2865 F. Rosshardt, London—Communicated by S. Montagne, France. Improvements in the method of and means for extracting the tin from tinned sheet metal cuttings by means of hydrochloric acid gases. February 27
- 2867 J. H. Johnson, London—Communicated by La Société Anonyme de Commeny-Fourchambault, France. Improvements in the manufacture of iron and steel. February 27
- 2870 R. Stone, London. Improvements in smelting, and machinery and appliances for carrying same into effect. February 27
- 3138 G. T. Lewis, London. Improvements in the smelting of tin ore, and recovering tin from tinned sheet iron scraps. March 5
- 3143 J. A. du Reitz, London. Improvements in coating sheet iron and other materials with zinc, and in apparatus therefor. March 5
- 3293 T. C. Huntington and M. Chiapponi, London. Improvements in effecting the extraction of antimony from ores or compounds containing the same. March 9
- 3346 F. W. Martino, London. New or improved alloys of zinc. March 9
- 3379 J. H. Thomas, London. Improvements in or applicable to the manufacture of tin andterne plates, and sheet metal or coated sheets. March 10
- 3380 W. E. Gedde, London—Communicated C. M. Pielsticker, Russia. Improvements in the machinery and process for the manufacture of plates and bars of steel, and of other metal. March 10
- 3389 J. E. Craig, London. Improvements in the manufacture of sheet iron. Complete specification. March 10
- 3448 F. Brain, London. A novel method of shot-firing and blasting in mines, by the agency of electricity. March 11
- 3457 W. D. Allen, London. Improvements in furnaces for melting or melting and treating pig iron, and in feeding or charging the same. March 11
- 3498 E. Fox, London. Improvements in casting metals in chill moulds, and in means or apparatus employed therein. March 12
- 3540 A. M. Clark, London—Communicated by La Société Scola et Ruggieri, France. An improved electric fuse for blasting purposes. March 12
- 3632 L. A. Groth, London—Communicated by C. Becksteio, Germany. A new or improved glowing powder for hardening metals. March 15
- 3674 A. F. Harris, Birmingham. Improvements in electroplating apparatus. March 16
- 3684 C. Clarke, Birmingham. A new or improved process of producing a "coloured gold" surface on articles of gold or other metal or alloy. March 16
- 3702 E. B. Parnell, London. An improved process of treating certain descriptions of auriferous and argentiferous material for the purpose of facilitating the separation of the metals contained therein. Complete specification. March 16
- 3746 J. F. Hall, Sheffield. Improvements in armour plates. March 17
- 3770 J. B. Spence, London. Improvements in obtaining aluminium from salts of alumina. March 17
- 3836 A. Kurzwehnart and E. Bertrand, London. An improved mode of and apparatus for casting ingots of steel or ingot metal. March 18
- 3867 A. M. Clark, London—Communicated by H. Harnet, France. An improved basic lining for metallurgical apparatus. March 18
- 3878 R. Hanson and J. Fernie, Sheffield. An improved open hearth furnace for steel melting and other purposes. March 19
- 3907 W. F. Richards, London. An improvement in the manufacture of tin plates. March 19

- 3985 C. E. Steinweg, London. A process for plating metals and metallic alloys. Complete specification. March 22
- 3986 J. M. White, Darlington. Improvements in furnaces for the manufacture of metallic sleepers. March 22

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 4741 F. J. P. Cheesbrough. Manufacture of iron and steel direct from the ore, with gaseous fuel; and apparatus. February 26
- 6039 J. Heath and W. Frost. Method of blasting and shot firing mines. March 19
- 6317 G. M. Edwards. Machinery and appliances for dressing, etc., mineral ores. March 9
- 6873 J. Giers. Manufacture of steel. March 16
- 6894 J. McCulloch. Preparing ores, oxides, or compounds of iron for smelting or reducing. March 16
- 7510 P. Jonson—Communicated by J. Omholt and The Chemische Fabrik Gossnitz. Continuous manufacture of light metals by application of electrolysis; and apparatus therefor. March 23
- 7571 G. A. Jarvis and A. E. Tucker. Manufacture of steel converter bottoms, plugs, or blocks. March 12
- 7740 J. M. H. Munro. Treating basic cinder to obtain products useful as manures, etc. March 9

XI.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

- 2762 E. Edwards, London—Communicated by L. Rivière, France. An improved process for the saponification of fatty bodies. February 25
- 2800 A. E. Scott, London. A cleansing fluid. February 26
- 2821 B. Nickels, London. Improvements in the treatment and purification of spent soap lyes and crude glycerine obtained therefrom. February 26
- 3030 J. Longmore, Liverpool. Improvements in the treatment or utilisation of cotton-seed oil residue. March 3
- 3512 E. J. Digby, London. A lubricant. March 12
- 3518 B. J. Hicks and J. Kirkwood, London. An improved lubricating composition. March 12
- 3644 A. W. McIlwaine, London. Improved means applicable for use in extracting oils by volatile solvents. March 15
- 3749 A. F. Craig, A. Neilson, and J. Snodgrass, Glasgow. Improvements in apparatus for separating mineral or other oil from oils or substances of different specific gravities. March 17
- 3987 J. Townsend, Glasgow. Improvements in making soaps. Complete specification. March 22

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 3725 M. G. Coltart and J. Menzies, Glasgow. Manufacture of oleaginous compounds for batching wool, etc. March 16
- 6562 C. D. Abel—Communicated by L. Hugues. Apparatus for subjecting neutral fatty bodies to the action of water at high temperature, and for the direct production of fatty acids and glycerine. March 19
- 7454 P. Brintini. Saponaceous material for washing purposes. March 16

1886.

- 1525 C. Fink. Lubricating compounds. March 2
- 1939 J. Whittle. Extracting oil or grease from cotton-waste, etc., and apparatus therefor. March 12

XII.—PAINTS, VARNISHES, AND RESINS.

APPLICATIONS.

- 2789 D. Swan, Glasgow. Improvements in obtaining pigments. February 26
- 3513 E. J. Digby, London. Steam boiler and iron varnish. March 12
- 3636 A. C. Ireland and J. R. Bowbeer, London. An improved composition or paint for preventing attachment of barnacles to the bottoms of iron and steel-plated ships. March 15

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 6844 M. Schumann—Communicated by H. Graf. An improved metallic paint. March 19

1886.

- 1511 E. W. McClave. Distilling turpentine and purifying the crude products thereof. March 9

XIII.—TANNING, LEATHER, GLUE AND SIZE.

APPLICATION.

- 3511 J. S. Billwitter, London. Process for tanning skins. March 12

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 11880 J. W. Davies. Industrial utilisation of leather waste. March 23

1886.

437 A. J. Hailes. Preparation of skins, kips, and hides, by improvement in the process of "puring" or "bating." March 5

1554 W. R. Lake—Communicated by W. M. Hoffmann. Improvements in "putting out" and "striking out" machines for the preparation of calf and other skins. March 2

XIV.—AGRICULTURE, MANURES, Etc.

COMPLETE SPECIFICATION ACCEPTED.

1885.

6153 W. Grimshaw. Treating and drying excreta, and manufacturing same into manure. March 5

XV.—SUGAR, STARCHES, GUMS, Etc.

APPLICATIONS.

2765 M. Kiefe, London. A process and apparatus for obtaining pure sugar from molasses. February 25

2812 C. D. Abel, London—Communicated by L. Markle, Germany. An improved internal coating for sugar moulds. February 26

3001 W. T. Crooke and A. A. Arnold, London. Improvements in the cleansing of "pockets" or bags employed in the manufacture of sugar, honey, or other like substances, and in the means employed therefor. March 3

3116 M. F. Heddle, D. C. Glen, and D. Stewart, Glasgow. Improvements in filtering and decolourising sugar, syrups, and other liquids, and in preparing a material therefor. March 5

3196 R. Englert and F. Becker, London. Improvements in the process of purifying saccharine juices. March 6

3556 E. Fahrig, Manchester. Improvements in the manufacture of sugar by electrolysis. March 13

3609 J. D. Scott and A. Scott, Glasgow. Improvements connected with vacuum pans for concentrating sugar solutions. March 15

3628 H. E. J. Selwig and B. C. A. C. Lange, Liverpool. Improvements in the manufacture of sugar blocks, and apparatus therefor. March 15

3727 H. H. Lake, London—Communicated by the Societe Nouvelle des Raffineries de Sucre de St. Louis, France. Improvements relating to the refining of sugar, and to apparatus therefor. Complete specification. March 16

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

6358 L. Lefranc. Process for extracting juices, syrups, and molasses. March 5

7098 O. Korschelt—Communicated by H. Soxhlet. Manufacture of grape sugar. March 23

8843 G. M. Newhall and J. H. Tucker. Treating sugar and like substances, and apparatus therefor. February 26

1886.

1108 A. M. Clark—Communicated by J. J. Haug and C. Hoffmann. Manufacture of a substitute for caoutchouc and gutta-percha. February 26

1888 W. R. Lake—Communicated by F. O. Matthiessen. Filters and apparatus for purifying sugar-liquor. March 19

1889 W. R. Lake—Communicated by F. O. Matthiessen. Dischargers for filtering apparatus used in the purification of sugar-liquor. March 16

1890 W. R. Lake—Communicated by E. E. Quimby. Filtering apparatus for purifying sugar-liquor. March 16

1891 W. R. Lake—Communicated by R. C. Howes. Filtering apparatus for use in the purification of sugar-liquor. March 16

1914 J. McClure C. Paton. Triple effect evaporating apparatus used in the manufacture of sugar. March 23

XVI.—BREWING, WINES, SPIRITS, Etc.

APPLICATIONS.

2601 J. Wright, London. Improvements in the processes of distillation and rectification. Complete specification. Feb. 23

2629 A. W. Gillman, S. Spencer, and E. S. Spencer, London. Improvements in machinery or apparatus employed in steaming grain or cereals to be used in brewing, distilling, and vinegar making. February 23

2866 F. E. V. Beanes, London—Communicated by E. Beanes, France. Improvements in means for the treatment of liquids prior to their being bottled or enclosed for keeping. Feb. 27

3298 H. R. Matthews and C. G. Matthews, London. The aeration or supersaturation of definite or standard mixtures of pure and potable wines or spirits with spring water, or any natural or manufactured mineral water or beverage. March 9

3603 H. H. Lake, London—Communicated by J. W. Noll, Germany. An improved method of and apparatus for renovating or freshening beer or similar liquids. March 13

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

4392 J. H. Johnson—Communicated by L. Morel. Apparatus for raising beer, etc. March 2

4988 H. J. Haddon—Communicated by P. Lauth. Apparatus for drying malt, etc. March 2

5647 G. Barker. Apparatus for aerating malt and other liquors. March 5

6213 J. C. Mewburn—Communicated by G. Noback and W. Gintl. Treating waste products from brewing and similar processes. March 2

7788 L. Cuisinier. Preventing from alterations the saccharification of amylaceous substances by malt. March 12

1886.

2601 J. Wright. Improvements in processes of distillation and rectification. March 23

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

APPLICATIONS.

A.—CHEMISTRY OF FOODS.

2646 A. M. Clark, London—Communicated by A. L. Saint Aubin, France. An improved process and apparatus for treating coffee. February 23

2871 A. W. M. Leicester, London. A process for preserving fruits. February 27

2909 C. Hansen, London. Improvements in the treatment of rennet. March 1

3124 W. Garthwaite, Great Grimsby. Producing "fish-biscuit" for dogs, and food for poultry, game, etc. March 5

3191 A. T. Wedelin, London. Preserving animal and vegetable substances. March 12

3910 C. J. Henderson, Edinburgh. Preserving fish. March 20

B.—SANITARY CHEMISTRY.

2721 R. de Soldenhoff, London. Improvements in furnaces for the desiccation, incineration, and carbonisation of precipitates or solids resulting from sludge or other substances liable to putrefy, etc. Complete specification. February 24

2752 F. H. Colley, Sheffield. Improvements in the process of purifying sewage or drainage from tanneries, dye works, factories, or other sources. February 25

3217 J. B. Hannay, Glasgow. Improvements in treating sewage and making cement. March 8

3626 W. Berridge, Windsor. Sanitary improvements applicable to water-closets and urinals, etc. March 15

3730 C. W. Burton and F. T. Moison, London. Improvements relating to the purification of water. March 16

3731 C. W. Burton and F. T. Moison, London. Improvements relating to the purification of water, and to apparatus therefor. March 16

3826 J. G. Lorrain, London. Improvements in the formation of organic oxides, and in the oxidation of matter suspended or dissolved in liquids. March 18

3973 J. W. Slater, S. K. Page, W. Stevens, and The Native Guano Co., Limited, London. Improvements in the preparation of materials for use in the treatment of sewage and foul water. March 20

C.—DISINFECTANTS.

2780 J. G. Swan and R. M. W. Swan, Glasgow. A sheep dipping and disinfectant composition. Complete specification. February 22

3861 R. V. Tuson, London. Improved preparations to be used for the destruction of insects and parasites on sheep and other animals. March 18

COMPLETE SPECIFICATIONS ACCEPTED.

A.—CHEMISTRY OF FOODS.

1885.

5295 J. W. C. Meiler. Malt cocoa. March 2

6050 D. Ker. Manufacturing from cocoa in any form a paste soluble in cold water of any temperature. March 2

7056 H. T. Johnson. Vessels for keeping cool and preserving food. March 19

1886.

1112 W. A. Murray. Manufacture of butter. March 2

B.—SANITARY CHEMISTRY.

1885.

4981 F. J. Austin. Apparatus for disinfecting, deodorising, or precipitating purposes. March 12

5153 J. Hewes. Treatment of excreta and house sewage, and material and apparatus therefor. March 16

5172 L. Schroter. Apparatus and process for purifying and filtering waters. March 9

6653 T. Bradford. Disinfecting apparatus. March 16

1886.

1053 G. H. Leame. Method of continuous filtration, applicable to the purification of sewage. March 5

C.—DISINFECTANTS.

1885.

12985 W. D. Borland. Obtaining granulated antiseptic preparations. March 2

XVIII.—ELECTRO-CHEMISTRY.

APPLICATIONS.

- 2615 C. J. Hall and W. Lowrie, London. Improvements in absolutely continuous current dynamo-electric machines. February 23
- 2625 R. Harrison, London. Improvements in primary electric batteries. February 23
- 2631 J. Y. Johnson, London—Communicated by L. A. W. Desruelles, France. Improvements in electric batteries. February 23
- 2632 J. Y. Johnson, London—L. A. W. Desruelles. Improvements in the treatment and preparation of materials used in electric batteries. February 23
- 2647 L. N. Loeb, London—Communicated by J. H. Howard, United States. Improvements in galvanic batteries. February 23
- 2648 J. N. Loeb—J. H. Howard. Improvements in galvanic batteries. February 23
- 2704 A. Thompson and J. G. W. Fairbairn, London. Improvements in dynamo-electric machines. February 24
- 2773 A. M. Clark, London—Communicated by C. R. Goodwin, France. Improvements in voltaic batteries. February 25
- 2871 J. Musgrove—Musgrove, London. Improved apparatus or appliance for effecting the circulation of solutions in primary and secondary electrical batteries. February 27
- 2880 H. H. Lake, London—Communicated by G. E. Cabanellas, France. Improvements in and relating to apparatus for the generation and utilisation of electrical energy. February 27
- 2932 A. Schanschiff, London. Improvements in galvanic batteries. March 1
- 2956 M. Immisch, London. Improvements in electric motors and dynamo machines. March 2
- 2975 N. Tesla, London. Improvements in dynamo-electric machines. March 2
- 3183 T. A. Garrett, London. Improvements in and connected with dynamo-electric machines or motors. March 6
- 3235 C. J. Hall and W. Lowrie, London. Improvements in absolutely continuous current dynamo-electric machines. March 8
- 3253 H. H. Lake, London—Communicated by F. Heimel and F. Waldmann, Austria. Improvements relating to the conversion of electric currents, and to apparatus therefor. March 8
- 3475 R. E. B. Crompton, London. Improvements in dynamo electric machines. March 11
- 3476 A. Schanschiff and G. R. Fludder, London. Improvements in galvanic batteries. March 11
- 3554 W. Hartnell, Leeds. Improvements in dynamo electric machines. March 13
- 3577 A. C. Henderson, London—Communicated by E. Bazin, France. Improvements in the method of depolarising electric batteries. March 13
- 3605 J. Y. Johnson, London—Communicated by E. A. G. Street (otherwise Charles Street), and A. L. W. Desruelles, France. Improvements in means or apparatus for producing and regulating or controlling electric currents. March 13
- 3726 H. H. Lake, London—Communicated by J. Serson, United States. Improvements in galvanic batteries. Complete specification. March 16

COMPLETE SPECIFICATIONS ACCEPTED.

1881.

- 16437 J. S. Williams. Preparation and application of materials, etc., for the construction of electric apparatus cells, chambers or dielectrics. March 16
- 16438 J. S. Williams. Electric accumulators or batteries. March 16

1885.

- 2765 W. R. Lake—Communicated by A. Marchenay. Electrical accumulators or secondary batteries. February 26
- 6088 E. B. Burr. Galvanic batteries. March 5
- 8331 A. M. Clark—Communicated by C. R. Goodwin. An improved carbon element for galvanic batteries. March 12
- 13036 A. Bernstein. Carbons for incandescent lamps. March 23
- 15040 S. W. Maquay. Improved voltaic battery. March 19

1886.

- 1151 W. W. Popplewell—Communicated by F. La Otis Lathrop, J. W. Carter, and C. Fabre. Galvanic batteries. February 26
- 1160 W. P. Thompson—Communicated by A. H. Cowles. Smelting ores by electricity, and apparatus or furnaces therefor. March 23
- 1161 W. P. Thompson—Communicated by E. H. Cowles and A. H. Cowles. Lining for the walls of electric furnaces. February 26
- 1351 H. J. Allison—Communicated by E. M. Gardner. Electrode for secondary batteries. March 2
- 2403 H. J. Haddan—Communicated by E. H. Cowles and A. H. Cowles. Operating electric smelting furnaces. March 19

XIX.—PAPER, PASTEBOARD, ETC.

APPLICATIONS.

- 2656 O. W. G. Briggles, London—Communicated by Dr. J. F. Riep, Holland. Improvements in the treatment of reha and other fibres. February 23
- 2915 J. C. W. Stanley, London. Improvements in the preparation of materials suitable for being made into paper and for other purposes, and in apparatus therefor. March 1
- 3061 J. M. Walton, Manchester. Improvements in the construction and lining of boilers employed in the manufacture of paper-pulp from wood and other fibres. March 4
- 3111 H. Watson, Newcastle-on-Tyne. Improvements in strainer plates used in the manufacture of paper. Complete specification. March 5
- 3472 J. D. Tompkins, Nassau, United States. Improvements in process of making paper stock or pulp. Complete specification. March 11
- 3840 F. S. Reisenberger and M. C. Keith, London. An improved process for the manufacture of "half-stuff" for paper making. March 18

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 5585 C. Weygong. Sizing paper and such like material. March 19
- 6839 R. C. Menzies, C. F. Cross, and E. J. Bevan. Preparation of paper-pulp from straw, esparto, wood, etc. March 19
- 7772 J. Petrie and F. W. Petrie. Machinery for cleansing "esparto" and other fibrous material used in making paper. March 16

1886.

- 2278 H. H. Lake—Communicated by C. E. Ball. Boilers or digesters for use in manufacturing paper-pulp. March 23

XXI.—EXPLOSIVES, MATCHES, ETC.

APPLICATIONS.

- 2692 D. L. Brain, London. Shell bursters for use with highly explosive agents. February 24
- 2715 G. F. Lutticke, London. An explosive projectile for toy cannons, guns, pistols, and the like. February 24
- 2716 E. G. Brewer, London—Communicated by L. Schoentjes and A. Jess, Germany. Improvements in or connected with fog signal apparatus. Complete specification. February 24
- 2974 F. W. Macan and W. J. Sharp, London. Improvements in the manner and means of attaching fuses to cartridges. March 2
- 3142 J. N. Heidmann, London. A new explosive compound. March 5
- 3313 E. Luck and A. Luck, London. Improvements in the manufacture of explosives. March 9
- 3399 C. W. Curtis and W. J. Brown, London. Improvements in the manufacture of gunpowder. March 10
- 3578 A. H. Burnford, London. Improvements in the manufacture of gunpowder. March 13
- 3593 O. Bowen, A. S. Tomkins, and J. Cobeldick, London. An improvement in the manufacture of gunpowder. March 13
- 3701 F. B. W. Roberts, R. Gansden, and A. Luck, London. Improvements in the manufacture of explosives. March 16
- 3901 W. Wells and C. F. Thompson, London. Improvements in fuzes for exploding shells, to be called "Wells's rotary needle sensitive fuze." March 19
- 3977 T. Birkett, Birmingham. A new or improved device for testing the force of guns, pistols, or powders of any kind. March 22

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 5252 H. E. Newton—Communicated by A. Nobel. Explosive compounds. March 12
- 6517 W. Kennish. Explosive projectiles. March 12
- 6926 H. S. Maxim. Explosive compounds. March 23
- 7725 T. Smith. Safety dynamite shells, or shells loaded with other dangerous explosives. March 5
- 15129 E. Schultze. Manufacture of gunpowder and similar explosives. March 16

XXII.—GENERAL ANALYTICAL CHEMISTRY.

APPLICATIONS.

- 3170 E. Edwards, London—Communicated by P. Clair and J. B. Socard, France. An improved process for detecting fuchsine or other colouring matter of similar chemical composition in wine, vinegar, spirit, liquors, syrups, and other articles of the like kind. March 11
- 3591 S. A. Calderara and A. J. Calderara, London. An improvement in glass hydrometers. March 13

THE JOURNAL OF THE Society of Chemical Industry:

A MONTHLY RECORD
FOR ALL INTERESTED IN CHEMICAL MANUFACTURES.

No. 4.—VOL. V.

APRIL 29, 1886.

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NOTICES.

In accordance with the provisions of Rule 18 of the Bye-laws, notice is hereby given that those Members of Council whose names are placed in italics in the annexed list, will retire from their respective offices at the forthcoming Annual General Meeting.

Mr. David Howard has been nominated to the office of President, and Mr. E. K. Muspratt has been nominated Vice-president under Rule 11.

Sir H. E. Roscoe, M.P., has been nominated Vice-president under Rule 24; Dr. Ferdinand Hurter, Mr. John Williams, and Mr. Philip Worsley have been nominated Vice-presidents under Rule 8; and Mr. Eustace Carey has been nominated Ordinary Member of Council under Rule 17, in the place of Mr. John Williams, nominated Vice-president.

The Treasurer and Foreign Secretary have been nominated for re-election.

Members are hereby invited to nominate fit and proper persons to fill four vacancies among the Ordinary Members of Council under Rule 18. Special nomination forms for this purpose can be obtained from the General Secretary upon application.

Extract from Rule 18.—"No such nomination shall be valid unless it be signed by at least ten members of the Society, who are not in arrear with their subscriptions, nor unless it be received by the General Secretary, at the Society's Office, at least one month before the date of the commencement of the Annual General Meeting, to the election to take place at which it refers. Nor shall any such nomination be valid if the person nominated be ineligible for election under Rules 12 or 15. No member shall sign more than one nomination form."

ANNUAL GENERAL MEETING.

Members are hereby informed that the annual general meeting (1886) will take place in Liverpool on the 7th, 8th, and 9th of July. Details of arrangements will appear in due course. Tickets of membership will be issued in time for the meeting, and will form, as heretofore, vouchers for visits to works and excursions.

PROPOSED AMENDMENT OF BYE-LAWS.

Notice is hereby given, in accordance with Rule 54, that it will be proposed to the forthcoming Annual General Meeting to further amend the Society's Bye-laws as follows:—

Bye-law 1.—That the words "and is established in accordance with the provisions of the Literary and

Scientific Institutions Act, 1854," be added after the word "Industry."

Bye-law 5.—That the word "or" be inserted in the third line thereof between the words "Council" and "a professional."

Bye-law 27.—That the words "One Guinea" in the first line thereof, be replaced by the words "Twenty-five Shillings."

Bye-law 29.—That the words "is more than four months in arrear," in the second line thereof, be replaced by the words "has not been paid."

Bye-law 37.—That the word "President" in the second line thereof, be replaced by the word "Chairman."

Bye-law 42.—That the words "is in arrear with" be replaced by the words "has not paid."

Bye-law 49.—That the date "31st of December" be replaced by the date "15th of June."

Bye-law 54.—That the word "given" in the last line but one thereof, be replaced by the word "posted."

The supply of copies of the Journal for January, 1882, being now exhausted, the Secretary would be glad to receive communications from members possessing extra copies of that number, in good condition, with a view to purchase.

Should sufficient applications for complete sets be received, the number will be reprinted.

In reply to numerous inquiries, members are hereby informed that no tickets for the Colonial Exhibition have been supplied to the Secretary.

CHANGES OF ADDRESS.

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T. Felton, 1/o Upper Clapton; 364 Romford Road, Forest Gate, E.

R. C. Forster; Journals and communications to c/o Messrs. Bessler, Waechter & Co., Newcastle-on-Tyne.

H. Garton, 1/o Southampton; Southampton Wharf, Battersea, S.W.

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CHANGES REQUIRED.

H. W. Bishop, 1/o Wigginton Road, Tamworth.
Harry Chaney, 1/o Mortomley Hall, Sheffield.

LIST OF MEMBERS ELECTED, 21st APRIL, 1886.

Theodoro Baker, Clifden, Overcliff, Gravesend, chemical student.

Fred. Baxter, Ivy House, Abbey Street, Burton-on-Trent brewer.

W. A. Bradbury, Steeley Chemical Works, Worksoy, analyst and manager.

G. Burdakin, jun., Sutton Lodge Chemical Company, St. Helens, manager.

T. W. Carran, Girtton House, Sheil Road, Liverpool, chemist.

John Cochran, Spring Field House, New Mills, near Stockport, print works manager.

F. Douglas Everitt, Finstall House, Bromsgrove, student.

R. Jopling Fletcher, Vine Cottage, Hazel Grove, near Stockport, hat manufacturer.

James Hart, Embden Street, Manchester, pharmacist.

Etsnojo Horé, 71, Parliament Hill Road, Hampstead Heath, N.W., chemist.

A. E. Johnson, 10, Victoria Street, Wolverhampton, analyst.

E. Fielding Jones, Dalmonach, Bonhill, N.B., analyst.

Charles Lamb, 60, Mark Lane, London, E.C., chemical merchant.

G. W. Macalpine, Parkside, Acerington, colliery proprietor.

A. Reginald Norrington, Cattedown, Plymouth, sulphuric acid manufacturer.

A. E. Peacock, Waverley, Bridlington Quay, manager of chemical works.

Thomas Phipps, 169, Bridge Street, Northampton, brewer.

A. Ree, Philp, Apperley Bridge, near Leeds, chemist.

Enoch Whitehouse, 418, Coventry Road, Birmingham, works manager.

Deaths.

E. Hardon, 1/o Heaton Norris, Stockport.

C. O. M'Allum, 1/o 7, Dean Street, Newcastle-on-Tyne.

H. Shephard, 1/o 2, Orlando Road, Clapham, S.W. (3rd Feb.).

ERRATUM.

In the List of Members elected 23rd March, 1886, Mr. W. A. Gorman's initials were described as "J. H.," in error.

London Section.

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MEETINGS, SESSION 1885-86.—First Monday in each month (unless otherwise indicated).

ORDINARY MEETINGS.

First Monday in the Month, at 8 p.m.

May 3.—A. G. Salamon, A.R.S.M., F.C.S., and W. de Vere Mathew, F.I.C.—"The Purification of Water." Messrs. Macnab and Beckett—"The Treatment of Water for Technical Purposes."

June 7.—Dr. Meymott Tidy—"Chemical Treatment of Sewage."

July.—Annual Meeting at Liverpool.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held in the Lecture Theatre, Central Institution of the City and Guilds of London Institute, Exhibition Road, South Kensington, S.W., Monday, April 5, 1886.

DAVID HOWARD, ESQ., IN THE CHAIR.

THE TESTING OF PORTLAND CEMENTS.

BY PROF. W. C. UNWIN, M. INST. C.E.

ABOUT the year 1850 there was first produced a new cement, which from its resemblance to Portland stone when set, was called Portland cement. It has

the properties of setting rapidly and setting under water, and it slowly hardens to a condition in which it is nearly as strong as natural stone. In hardening, it has the very important quality of altering extremely little in volume. It rapidly established its superiority as a constructive material to Roman cement, and it bids fair, in spite of its greater cost, to largely supplant hydraulic lime. It can be kept with little deterioration and shipped to distant countries. Its use has extended till its manufacture has become one of the most important industries in this country, in Germany, in France, and in the United States.

Success in its manufacture depends on careful judgment and the rigid observance of essential conditions. It may be produced from a great variety of natural rocks, but broadly speaking, it consists of seventy-two per cent. of chalk and twenty-eight per cent. of clay.

Experience shows the exact proportion of the natural materials used which is most suitable. These materials must be so mixed that the cement is absolutely homogeneous and invariable in composition. At first, the chalk and clay were ground together with a large volume of water into a liquid slip. Now it is found that grinding with only thirty-five per cent. of water is not only economical, but prevents the segregation of materials which took place in fluid slip. With some materials no water is used in grinding. The mixed materials are then calcined to a clinker at a temperature just short of that which produces fusion. Underburnt clinker is weak, and overburnt clinker is an almost inert cement. Lastly, the clinker must be broken up and ground to a powder, so fine that the cement particles expose a maximum surface at which chemical actions may occur, and are not too large to fill the smallest inter-spaces in the sand with which the cement is mixed in use.

I must leave it to members of this Society more acquainted with chemical reactions than myself to decide on the nature of the hardening process, which gives its value to cement. Pettenkofer seems to make the process consist (1) in the formation of a silicate of lime and the hydration of the silicates of alumina and iron, (2) further in the reaction of the silicate of lime on the other silicates forming double hydrated silicates. According to Frey, there is (1) a formation of an aluminat of lime, and of hydrates which attain considerable hardness; (2) a reaction of the calcium hydrate on the basic calcium silicate. Experiment seems to show a progressive increase of combined water in hardening cement.

The primary guarantee of the goodness of a cement is, that it comes from a manufacturer who exercises the requisite care and who has appliances adequate for securing invariable quality in his product. But the enormous volume and cost of the cement used in engineering works has led to the adoption of special processes of testing, as a check on the manufacturer. In large works, like the Metropolitan Main Drainage, it was perceived that a considerable sum might economically be spent on systematic and regular tests of the quality of the cement supplied. A comparatively large sum spent in testing formed but a small percentage on the value of the cement, and as the quality of cement may vary through very wide limits, from qualities absolutely trustworthy to qualities absolutely dangerous, the cost of testing was fully repaid by the greater value of the cement obtained, and the thorough confidence with which after testing it could be used.

Testing began with comparatively crude tests of the tenacity of briquettes, or test pieces of neat cement, which at first were made of an excessively bad form, and were seldom tested after more than

seven days' hardening. It soon appeared that the form of these briquettes and the mode of making them greatly affected the apparent strength. Very insignificant differences in the quantity and temperature of the water used, and the time taken in ganging; in the pressure employed in moulding the briquettes, and so on, made differences in the apparent strength greater than the differences due to different qualities of cement. Diagram I. shows some of the forms used in testing for tenacity. The first form, Fig. 1, was excessively bad, the square corners producing unequal distribution of stress on the section. The most ordinary form is Fig. 5, which is simple to mould, and is held in clips, which embrace the specimen. A few engineers use forms like Fig. 7, in which the specimen is held between clips having a knife-edge passing through the enlarged end. There is probably something to be said for making the specimen longer than the common form shown in Fig. 5. The influence of the form of the briquette on the strength is considerable; different briquettes of the same cement, moulded in different forms, gave results at seven days, ranging from 280lb. per square inch for Fig. 1 to 460lb. per square inch for Fig. 5.

Gradually the proper form and the exact conditions for ganging briquettes of uniform quality have been determined by careful study, although it must be confessed that skill in ganging and moulding the briquettes still forms so large a factor in the results obtained, in the ordinary mode of testing, that it is difficult to get absolutely trustworthy comparative tests. Nevertheless, the chemical and physical properties present in the best cements have been ascertained. The manufacture has improved, and engineers now obtain cement of at least double the strength of that produced twenty years ago, and far more uniform and trustworthy.

The improvement of Portland cement, and the universal confidence now felt in its use, are due primarily to the experiments of Mr. Grant made between 1859—71, and communicated to the Institute of Civil Engineers in 1871. Since then many other engineers have made regular and scientific tests of large quantities of cement. But I believe undoubtedly the most careful, varied, and prolonged investigations have been made in the State Laboratories in Berlin and Munich. In this country cement testing has an exclusively commercial purpose in most cases. On the Continent the Government wisely provides means for researches, extending far beyond immediate requirements. The result has been a practical advance in the manufacture of a very marked kind.

I have here, for instance, a paper by Professor Bauschinger* of Munich, which indicates very remarkably the amount of care and labour devoted to investigations of this kind. Ten cements were tested. The weight, fineness, setting time, and chemical composition were first determined for each cement. Then mechanical tests on an unusually large scale were made. Test pieces were prepared and tested for four kinds of stress—crushing, tensile, transverse, and shearing. For each cement three series of test pieces were made—one set with neat cement, and two sets with one of cement to three of sand, and one of cement to five of sand. The tests were made for each of these sets, and for each of the four kinds of stress, both for test pieces hardened in air and hardened in water, and at periods of hardening of one, two, four, eight, sixteen, and 100 weeks.

The four tables of the results of these mechanical tests represent 7200 separate tests. In addition, there were tests of the ordinary small-sized test

* Mitth. aus dem mech. techn. Laboratorium der k. Hoehschule in Muenchen. 1879.

pieces, and subsidiary researches on the expansion of the cements after setting.

It may now be pointed out that there are two distinct objects in testing cement, involving to a certain extent quite different methods of procedure.

First, there is purely commercial testing, the object of which is to ascertain whether a cement satisfies contract conditions. In testing of this kind it is unfortunately unavoidable that the tests should be completed in a short time. To avoid freight expenses, the cement must generally be tested before it leaves the works at which it is manufactured. But as storage room is necessarily limited, a cement manufacturer cannot keep large volumes of cement for a period sufficient for perfectly adequate tests. Commercial testing has for the most part to be completed in a week, though at least a month is necessary for a really adequate test.

test, both fostered the production of coarsely ground and comparatively inferior cement. The great progress of the cement manufacture in Germany, and the production there of cements stronger in test and of more value in the market than English cements, is to be traced directly to the adoption of more rational tests.

In situ, a cement is hardly ever in tension, but ordinarily a tension test is adopted for determining its quality. It is never used neat, but always mixed with from three to twelve times its volume of the other substances, yet it is tested neat. It never is called on to resist stress till it has hardened for months; nevertheless, it is tested usually in seven days. Obviously the ordinary tests are empirical and may be misleading. Almost every circumstance which markedly affects the strength of a small briquette tested neat and soon after setting, produces a less effect on the

DIAGRAM I.

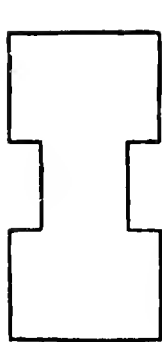


FIG. 1.

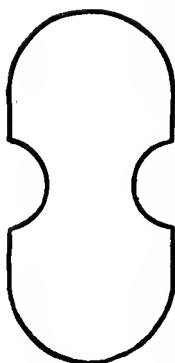


FIG. 2.

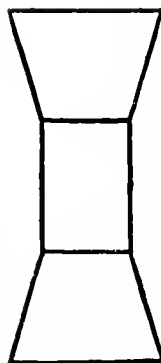


FIG. 3.



FIG. 4.

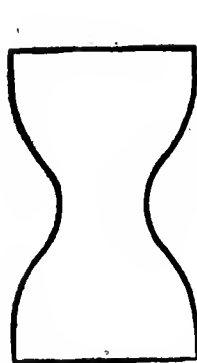


FIG. 5.

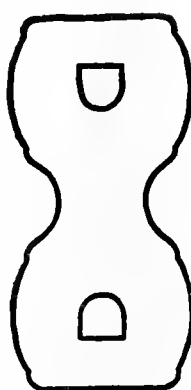


FIG. 6.

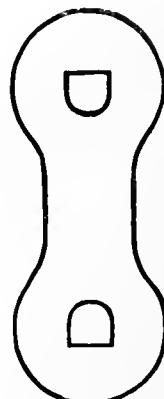


FIG. 7.

Second, there is scientific testing, the object of which is to afford information to the engineer. In this kind of testing, the conditions in which the cement is actually to be used must be imitated, and the tests must be extended over a not inconsiderable time.

Good commercial tests are those which enable us to detect with fair probability the qualities required by the engineer, so far as is possible in the restricted conditions in which such tests must be made. But they are necessarily imperfect, and just as a bad rule of tonnage measurement may directly tend to foster the production of bad and unseaworthy ships, so bad rules of commercial cement testing have contributed to hinder progress in cement manufacture. The brief neat cement tests, and the now obsolete weight

strength of a mass, mixed with other materials and tested after a longer interval of time. Hence, while it is impossible to alter the conditions of commercial testing, its empirical character requires to be steadily kept in mind, and its tendency to give an exaggerated estimate of differences in the cements tried. Further, the engineer is very unwise, if he does not, for his own satisfaction, carry out control experiments, larger in scale, more conformable to the conditions of use, and lasting a longer time than the tests which are necessary for contract purposes.

The constructional value of a building cement depends on two quite distinct elements—on its power of setting into a rigid form soon after it is gauged, and on its power of attaining in course of time a considerable strength. In the actual process of building,

especially building under water, it is important that the cement should set rapidly, and gain strength enough to keep its form. But, generally, it is only after the lapse of months, or even of years, that the structure is called on to exert its full strength. Hence any strength acquired by hardening during that time is advantageous.

Consequently, in judging of a cement from tests of its strength, both the initial strength acquired in a short time and the rate of gain of strength with age, require to be considered.

Now, suppose experiments have been made, say, at 7 days, 4 weeks, and 12 weeks. One would still like to be able to predict the strength at a greater age, and even in judging of the data in hand some difficulty arises from the discrepancies and anomalies incident to such experiments, and due to the difficulty of making the experiments numerous enough to get true average values. If anything were known of the

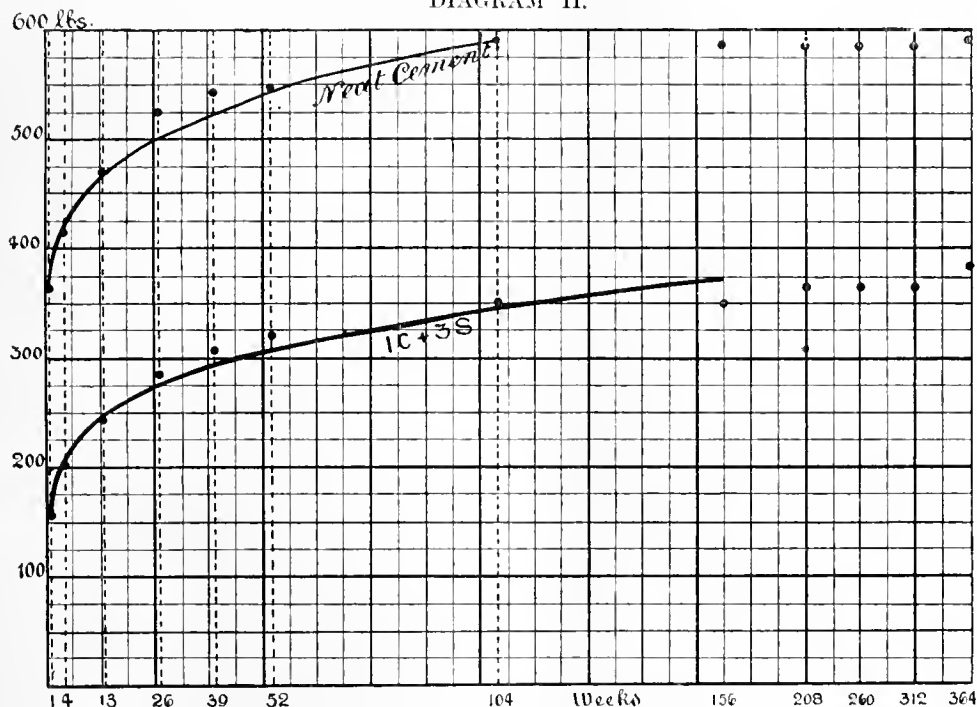
For all tension tests of Portland cement n may be taken as 1-3rd. For ordinary limes it has a larger value. For compression tests of comparatively large blocks of Portland cement n is 1-2nd. Consequently two tests of a cement at different ages determine the remaining constants of the formula.

If the equation is obtained from two such tests, the two constants indicate directly and simply the initial strength and rate of gain of strength with age, so that the equation may be termed the *characteristic equation* for the cement.

Further, if a series of tests at different ages are available, mean values of the constants can be obtained which give equal weight to all the results. The equation thus reconciles the anomalies which appear in all experiments of this kind. It virtually draws a smooth curve through the somewhat discordant results.

In applying the formula, I found very soon what

DIAGRAM II.



law of increase of strength with age, if we could put our results in a formula, their meaning would be much clearer.

Now the author has found that beyond the first week, and up to a period at which the full strength of the cement is reached, the rate of hardening follows very approximately a very simple law. For ordinary tension briquettes, for instance, the gain of strength is very nearly proportional to the cube root of the time of hardening, and that both for neat cement and cement mortar. It is possible, therefore, to represent the results of a series of tests in a simple formula, the constants of which indicate the character of the cement with very great clearness.

Let x be the number of weeks during which a test piece has been hardening. Then the strength y in lbs. per square inch at that age, is given very approximately by the equation—

$$y = a + b(x-1)^n$$

where a is the strength at 7 days, and b and n are constants depending on the rate of gain of strength with age.

does not appear so easily in tables of experiments, that neat cement briquettes generally reached their full strength in 3, or at most 4 months, while briquettes made with sand gained strength in a regular way up to 2 or 3 years at least. The formula, therefore, is only applicable within those limits of time.

The longest series of experiments with which I am acquainted is a series of experiments on briquettes of cement and cement mortar made by Mr. Grant, and extending over a period of 7 years. These experiments give the characteristic equations—

$$\text{Cement} \dots\dots\dots y = 363 + 48\sqrt[3]{x-1}$$

$$\text{Cement Mortar (1C+3S), } y = 157 + 40\sqrt[3]{x-1}.$$

Diagram II. shows these results for 3 years plotted with times as abscissa and strengths as ordinates. The experiments are shown by dots, and the strengths calculated by formula by the curves. The neat cement in this case gained in strength up to 104 weeks; the mortar briquettes probably longer, but beyond that time there was little or no gain.

The following table gives these results with the observed and calculated strengths :—

TESTS OF BRIQUETTES OF NEAT CEMENT, AND ONE CEMENT TO THREE SAND AT DIFFERENT AGES OF HARDENING (GRANT).

Age in Weeks.	Neat Cement. Strength in lbs. per sq. in.		1 Cement to 3 Sand. Strength in lbs. per sq. in.	
	Observed.	Calc.	Observed.	Calc.
1	363	363	157	157
4	415	431	202	214
13	470	471	244	249
26	525	500	285	274
39	542	521	307	292
52	547	513	320	305
104	590	589	351	345
156	585	—	350	372
208	585	—	363	—
260	580	—	365	—
312	580	—	364	—
364	590	—	383	—

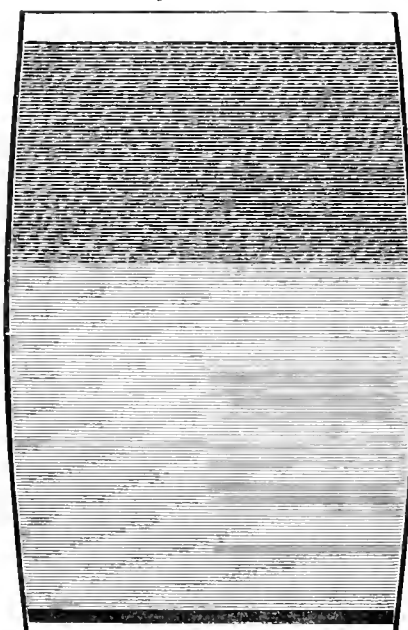
Fineness of Grinding.—The greater part of the improvement in the quality of cement, which has been effected in the last ten years, has been due to the discovery of the importance of grinding the clinker to extreme fineness. The amount of surface the par-

If cement is taken and sifted through a sieve of 50 meshes to the inch, the residue on the sieve of particles larger than the holes in the sieve will not adhere together sufficiently to form a briquette. They are almost absolutely without cementitious value. But if these same particles are reground they are converted into valuable cement.

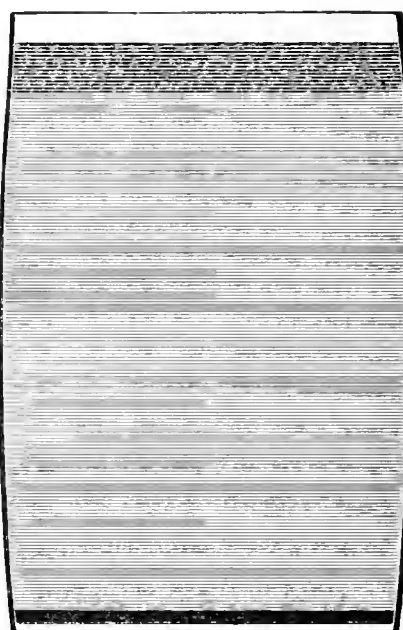
The extremely small value of these larger particles in the cement was not for some time perceived. For a long time all tests of the strength of cement, or nearly all, were made with neat cement, the reason being that tests of this kind can be made more rapidly than any others. Now, a good cement will bear the addition of a certain amount of inert matter without any sensible reduction of strength; indeed, with a certain gain. Hence it happens that in neat cement tests a somewhat coarsely ground cement gives results higher than a finely ground one. But cement is never, in fact, used neat; it is used mixed with three to seven or more times its weight of the cheaper material, sand or gravel. In the German laboratories, therefore, it was thought desirable not to test the cement neat, but to test it in the condition in which it is used in practice, mixed with sand; and directly this was done, it was found that the cements which were strongest tested neat were by no means always strongest tested as mortar mixed with sand. There may be more reasons for this than one, but the principal reason is that the more finely ground cement will bear a considerable addition of sand with less loss of strength than the coarsely ground cement. The coarse cement has, in fact, a proportion of matter as inert as sand already mixed with it.

Suppose a cement has 10 per cent. of inert matter;

DIAGRAM III.



60% FINE.



BARREL OF CEMENT.

90% FINE.

ticles of cement expose, increases inversely as the diameter of the particles. A cubic inch of cement would have 150 sq. ins. of surface, if the particles were spherical and $\frac{1}{25}$ th inch in diameter, and 600 sq. ins. if they were $\frac{1}{100}$ th inch in diameter; so that the area on which chemical action occurs increases as the cement is ground more finely. But probably this is only part of the explanation of the greater value of very finely ground cement.

then, when mixed with sand in the proportion of 2:1, the true ratio of cement to inert matter is 1 to 2.33; but if the cement initially contains 40 per cent. of inert matter, then, when mixed with double its weight of sand, the true ratio of cement to inert matter is 1:4.

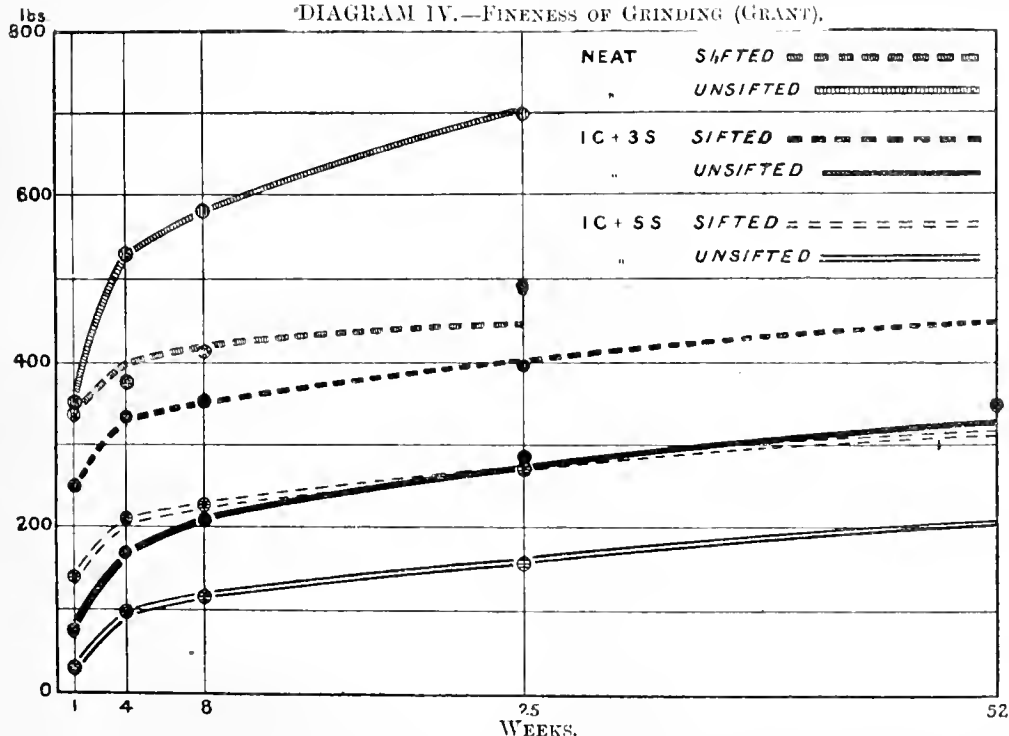
Diagram III. shows two barrels of cement, one containing 10 per cent. and the other 40 per cent. of particles, so coarse that they are practically of no more

value than sand. The difference of commercial value of the two cements is very easily seen. Since the coarse particles can be converted into good cement by grinding, the importance of fine grinding in developing the value of the cement is easily seen.

The Germans were the first to use the sand-mortar test instead of the neat cement test, and it has been

A series of experiments given in Mr. Elliot Clarke's very interesting "Report on the Boston Main Drainage Works" shows the effect of fineness of grinding still more strikingly. An English Portland cement was taken and divided into portions, which passed through a 50, 70, 100, and 120 sieve. Briquettes made with these and with different proportions of sand were

DIAGRAM IV.—FINENESS OF GRINDING (Grant).



directly due to this that they attach greater importance to fine grinding than English manufacturers. Improvement in England has gone on the same direction as in Germany, but it has not yet proceeded so far.

The best German cements are so ground as to leave a residue of only 3 to 10 per cent. on a 76-mesh (per inch) sieve. English cements, even well ground, leave 10 per cent. on a 50-mesh sieve.

Diagram IV. shows the results of a series of tests by Messrs. Dyckerhoff, given in Mr. Grant's paper. The same cement was used in all the tests; but in one series the cement was used as manufactured, in the other after sifting through a fine sieve. The former left 10 per cent. on a 50-mesh sieve; the latter all passed through a 180-mesh sieve.

The equations corresponding to the curves in the diagram are as follows:—

Neat cement.

Neat unsifted cement—

$$y = 353 + 122\sqrt{x-1}$$

Neat sifted cement—

$$y = 346 + 36\sqrt{x-1}$$

1 Cement + 3 sand.

Cement unsifted—

$$y = 75 + 69\sqrt{x-1}$$

Cement sifted—

$$y = 252 + 53\sqrt{x-1}$$

1 Cement + 5 sand.

Cement unsifted—

$$y = 31 + 46\sqrt{x-1}$$

Cement sifted—

$$y = 136 + 47\sqrt{x-1}$$

tested at different periods, from one week to 52 weeks. The following equations give the results:—

EFFECT OF FINENESS OF GRINDING (Boston).

Percentage which would not pass through a 100 sieve.	1 Cement + 3 Sand.	1 Cement + 5 Sand.
55	$y = 39 + 28\sqrt{x-1}$	$y = 19 + 10\sqrt{x-1}$
33	92 + 42	43 + 32
23	97 + 45	47 + 35
18	117 + 44	65 + 35
8	123 + 50	73 + 36
0	154 + 41	86 + 35

Heaviness of Cement.—It was early discovered that heavy, well-burnt clinker produced better cement than the lighter under-burnt clinker. Hence for a long time it was prescribed in all specifications that the cement should have a certain weight per bushel.

To get uniform results the cement is sifted through a very coarse sieve, and allowed to fall through a funnel three feet high into the standard measure. The cement is strickled off, and the measure weighed without shaking. The size of the measure must be defined, as the cement packs closer in a large than in a small measure. Bauschinger found 13 per cent. difference between the weight of cement in a 50-litre and a 1-litre vessel. But another influence affects the result. A cement ground coarsely will give a heavier weight

than the same cement ground finely, so that the weight-test is a premium on coarse grinding. Since this has been understood, the weight-test has been generally abandoned.

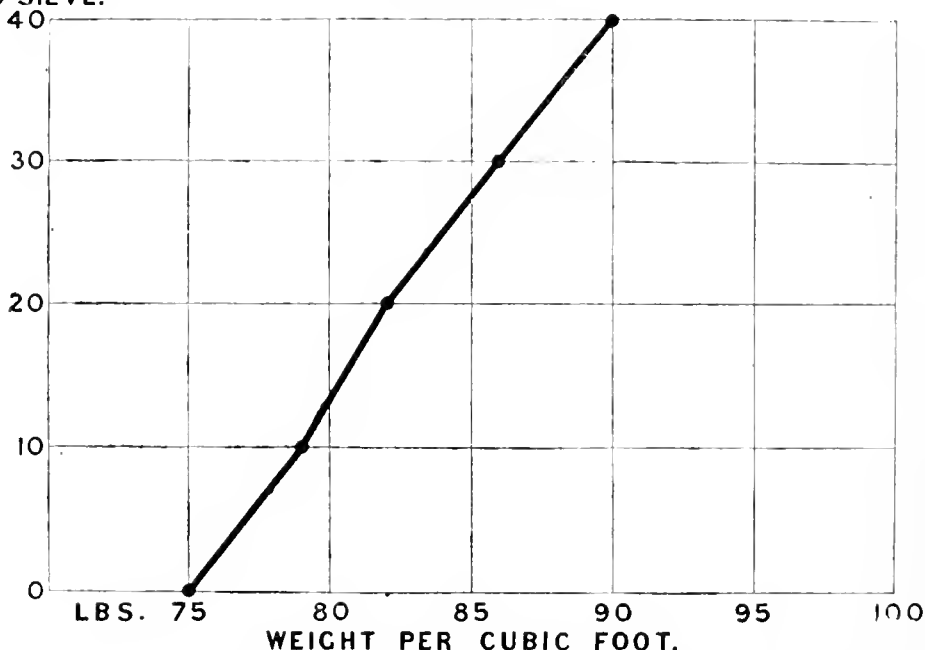
The weight per cubic foot of the same cement of different degrees of fineness was determined at Boston, with the following results:—

Per cent. retained on 120 sieve.	Weight per cubic foot.
0	75
10	79
20	82
30	86
40	90

Diagram V. shows these results plotted in a curve. It is still, however, convenient to know the weight per cubic foot, and if the fineness is taken into account it affords some indication of the quality.

PER CENT
LEFT ON
120 SIEVE.

DIAGRAM V.



Influence of the kind of Sand used in making Cement-mortars.—The sand used with cement in making mortar is commonly directed to be clean, sharp, silicious sand. It is usually specially directed that the sand should be free from clay. Experiment seems to show that a percentage of clay does not really harm the cement. But leaving this question aside, and supposing we have got a clean siliceous sand, tests will give very different results, according to the quality of the sand. For instance, experiments given by Mr. Grant with Berlin standard sand and a coarser sand give the following equations:—

Standard Berlin sand. Briquettes pressed—

$$y = 73 + 31\sqrt[3]{x-1}$$

Standard sand. Briquettes not pressed—

$$y = 89 + 19\sqrt[3]{x-1}$$

Coarser sand—

$$y = 172 + 28\sqrt[3]{x-1}$$

These experiments extended over a year. The experiments are plotted in Diagram VI.

Diagram VII. shows some experiments on a Portland and American (Rosendale) cement, made with a sand unsifted (marked *mixed* on the diagram), and on

portions of the same sand of different degrees of fineness obtained by sifting. It will be seen that the coarser sands give briquettes of greater strength; but the unsifted sand is nearly as strong as the coarsest. For use on works the mixed sand would be good, but for comparative experiments sand of a definite size is preferable.

By coarseness of the sand we mean, primarily, size of grain. Large-sized sand is good for exactly the inverse reason that fine cement is good. Fine cement coats a large surface, and fits well into the interspaces of the sand. Large-grained sand has less surface to coat, and its spaces are more easily filled with cement. Now, uniform size of grain may be obtained by sifting. Standard Berlin sand passes through a 20- and is retained by a 28-mesh sieve. But sands of uniform size of grain do not make equally good mortar. Two sands

sifted through and retained on the same sieves give different tests. There is something in the form of the grains and the kind of space between them—possibly even something in the chemical condition of the sand—which affects the initial strength and rate of hardening of the briquette. These different qualities are shown very clearly in the following characteristic equations, deduced from experiments by Mr. Arnold, at the Harbour Works at Willemshaven. The tests are 1 cement to 3 sand—the same cement used throughout.

Willemshaven blue sand—fine-grained and sharp—

$$y = 101 + 22\sqrt[3]{x-1}$$

Dangast normal sand, sifted in the same way as Berlin normal sand—not very sharp—

$$y = 124 + 23\sqrt[3]{x-1}$$

Dangast common building sand—

$$y = 165 + 13\sqrt[3]{x-1}$$

Wangeroog, coarser—clean and sharp—

$$y = 193 + 41\sqrt[3]{x-1}$$

Berlin normal, clean sharp quartz sand—

$$y = 250 + 44\sqrt[3]{x-1}$$

Influence of Proportion of Sand on the Strength of the Mortar.—Cement mortars are weaker than neat cement, probably because the adhesion of the cement

1 cement to 3 sand, the whole of the interstices of the sand cannot be filled with cement, and as the proportion of sand increases the proportion of unfilled space

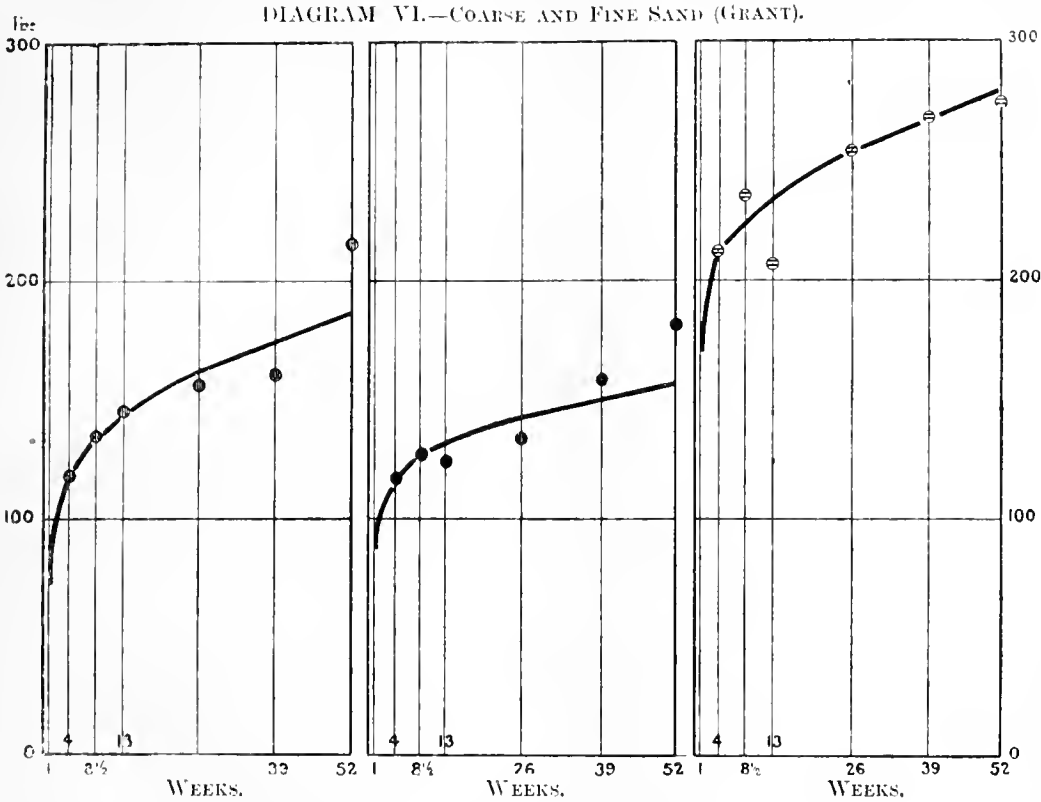
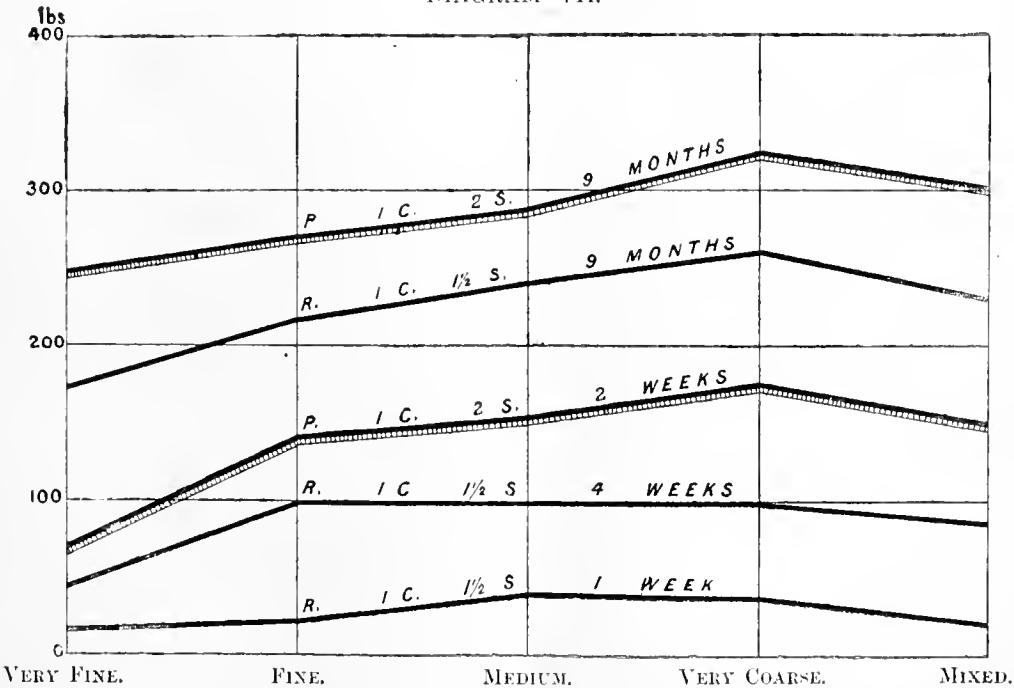


DIAGRAM VII.



to the sand is less than the tenacity of the cement. The larger the proportion of the sand the weaker the mortar. It appears that even with a proportion of must increase, and therefore there must be a less section to break.

From a series of tests, by Mr. Elliot Clarke, of

about 500 briquettes, all made with the same cement (the tests extending over two years), I get the following very uniform series of equations :—

PORTLAND CEMENT MORTAR, WITH DIFFERENT PROPORTIONS OF SAND (Boston).

Neat Cement	$y = 303 + 61\sqrt[3]{x} - 1$
1 Cement+1 Sand	160+57 ..
1 .. +2 ..	126+41 ..
1 .. +3 ..	95+36 ..
1 .. +5 ..	55+26 ..

Below are given the results of experiments by Dr. Böhme on the influence of the addition of various substances to cement. Some of these, such as gypsum, have been added at times with an idea that they improved the cement; others have been added occasionally as adulterations. Slacked lime has occasionally been used with cement in very cold weather. It will be seen that, with the exception of sifted cement, every one of these additions reduces the strength of the cement :—

VARIOUS ADDITIONS (Böhme).

(A, Cement; B, Sifted cement; C, Fine sand; D, Slag; E, Brick-dust; F, Slack-lime.)

MIXTURE.	Neat.	1 Cement to 3 Sand.
100 A	$y = 583 + 88\sqrt[3]{x} - 1$	$y = 199 + 18\sqrt[3]{x} - 1$
90 A+10 B	498+93	213+45
90 A+10 C	526+69	128+65
90 A+10 D	469+77	128+59
90 A+10 E	452+107	137+58
90 A+10 F	514+71	155+48
50 A+50 F	262+88	82+44

Effect of Time of Setting on the Qualities of a Cement.—There is a prevalent opinion that quick-setting cements do not continue long to gain in strength, but reach a maximum, and then fall off, or diminish in strength. This curious diminution in strength, often shown in experiments, may be due to minute and imperceptible cracks, but I am a little inclined to think that it is rather an error of testing than a real loss of strength. The cement, no doubt, gets more brittle, and that has the effect of making the test more difficult, and increasing the chance of breaking the briquette with a load rather less than the real tenacity.

Mr. Grant has given a table of tests of quick and slow cements, from which I have deduced the following characteristic equations. Mr. Grant does not say, but I believe these are 28-day tests of mortar gauged 1 to 3 of sand :—

Set in Minutes	Quick Cements.	Set in Hours.	Slow Cements.
10	$y = 7 + 95\sqrt[3]{x} - 1$	5	$y = 166 + 80\sqrt[3]{x} - 1$
20	34+113	7	101+94
30	83+86	10	113+70
45	23+90	11	140+67

These results show that the slower cements have very much greater initial strength than the quick cements, but I think the quick cements in this table

are somewhat exceptional. Taking the means of four series of tests on quick cements and four on slow cements from Bauschinger's tables, I get the following equations :—

	Quick Cements.	Slow Cements.
Gauged neat.....	$y = 183 + 18\sqrt[3]{x} - 1$	$y = 220 + 55\sqrt[3]{x} - 1$
1 Cement to 3 Sand	$y = 76 + 36\sqrt[3]{x} - 1$	$y = 88 + 47\sqrt[3]{x} - 1$

Here the slow cements have greater initial strength and greater rate of gain with age than the quick cements, but the difference is not so great as in Grant's table. At any rate, the opinion is general that the slower cements are more trustworthy. The German manufacturers propose different standard tests for quick and slow cements, the standard being higher for the slow cements.

Influence of Quantity of Water on the Strength of Neat Cement and Cement Mortar.—A certain quantity of water must be used in gauging cement or cement mortar, which varies with the character of the cement. The finest ground and quickest cements require most water. Now, unfortunately, every drop of water added beyond what is necessary weakens the cement, and this is the chief source of the discrepancies which occur in cement testing. In purely commercial testing, it is naturally and not unfairly desired to get the best result possible out of the cement. In this country the briquettes are moulded on an impervious slab of slate or marble or glass. The cement is gauged neat with the least amount of water which will permit moulding, and the very stiff paste into which the cement is formed is pressed into the moulds as rapidly as possible. To get uniform results, the water used must be very accurately measured. It varies from 18 to 25 per cent. of the weight of cement.

In Diagram VIII. are shown the results of some experiments at Boston, on the same cement, mixed with different proportions of water. The greatest strength is obtained with between 20 and 25 per cent. of water. The proportionate difference of strength as the time of hardening increases is less, so that it is for short, one week tests, that the quantity of water makes the greatest difference.

In Germany it has been found that if an absorbent block of gypsum is used under the briquettes in moulding, 5 per cent. more water may be used, and more uniform results obtained. Although the gypsum block is hardly ever used in this country, I think it is a distinct advantage that it permits us to gauge the cement to a condition in which it can be poured into the moulds without pressure. But in Germany the sand and cement, or cement mortar test, is almost always used, and in this test the quantity of water used does not influence the strength so largely as in the neat cement test.

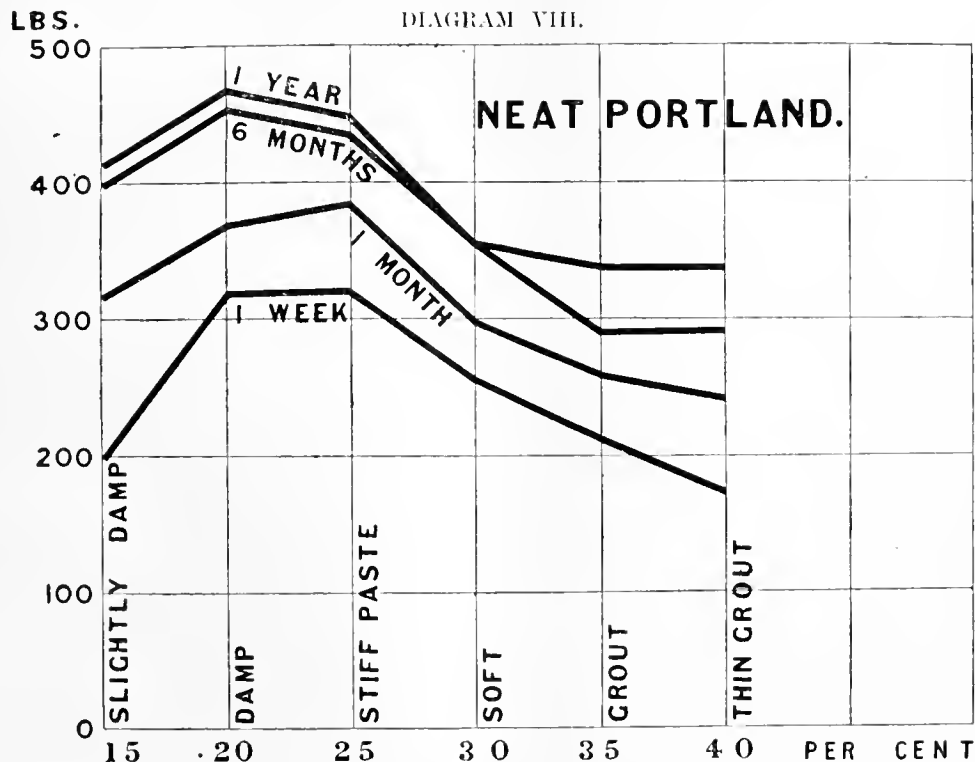
The sand or mortar test has other advantages. It corresponds more closely to the conditions in which the cement is actually used, and in plotting the results of experiments I have always found that sand tests plotted in smoother curves than neat cement tests. Against these advantages the cement and sand test has one drawback, which almost precludes its use in ordinary commercial testing, and that is that the cement mortar hardens more slowly than neat cement, so that 28 days at least should be allowed for the test. But if a neat cement test is adopted for contract purposes, the engineer should make cement and sand tests for his own information.

Test for Soundness.—One of the most dangerous qualities of a cement is a tendency to blow or crack after setting, in consequence of expansion due to the

chemical actions which are going on. Expansion of this kind producing cracks is commonly due to the presence of unslacked lime in the cement; gypsum added as an adulteration is open to the same objection. These substances are the more dangerous that they rather add to than detract from the strength of the cement, and hence escape detection by the ordinary test.

That Portland cement does expand in hardening may be shown easily by filling lamp glass chimnies with the cement, and placing them for hardening in water. This was done at the Boston sewerage works. With both neat cement and cement and sand, the chimnies invariably began to crack about the third day, and in the course of 10 days the glass cracked all over. Some glasses cracked in this way are placed on the table.

Measurement of Expansion of Cement.—Bauschinger took cubes of cement of 4.8 inches length of side. Twenty-four hours after mixing, a small brass plate, about $\frac{1}{16}$ -inch diameter, was fixed into two opposite sides of the cube, by cementing. After 48 hours' hardening, the accurate measurements between the brass plates were commenced. The cube was placed in a measuring instrument, having a spring touch lever on one side and a micrometer screw on the other. The touch lever ensured the constancy of pressure between the measuring points and the block to be measured. The pitch of the screw was very accurately determined, and as a perfectly constant temperature cannot be insured in experiments lasting a long time, a correction for the expansion of the cement blocks by heat was determined.



The ordinary test for soundness is to make a pat or cake, two or three inches in diameter, and half-an-inch thick, with thin edges, and place it in water. If the cake, in hardening, shows any tendency to crack or contort, the cement is dangerous.

It is often extremely important to determine the soundness of a cement in a shorter time than this process requires. Now, heat accelerates greatly the hardening process, and hence sometimes the pats of cement are placed on an iron plate heated by a gas jet. Then any tendency to crack shows itself in a short time. This may be called the baking process.

A still better process is to heat the pats in a steam bath. Mr. Faija makes a convenient apparatus, consisting of a double bath with regulated gas jet. The water in the outer bath is kept at 110°, and the pats placed in the steam on a slip of glass, in the inner bath, are in vapour at about 100°. After 5 or 6 hours the pat is hard enough to be placed in the water, and may be kept cooking for 20 hours. If at the end of that time the pat is still adherent to the glass, and without cracks, the cement is perfectly sound.

Neat cement briquettes hardened in air sometimes showed a small expansion at first, but all ultimately shrunk in volume. Neat cement briquettes hardened in water all showed a very small expansion, generally less than .05 in. in 120 mm. length in 16 weeks. With briquettes mixed with sand the changes of volume were of the same kind, but smaller.

Quickness of Loading.—I believe Mr. Faija first pointed out that the rate of loading a briquette affected the breaking weight. The quicker a briquette is loaded the greater the load which can be got on before it gives way. In some definite experiments, Mr. Faija found a difference of 23 per cent. in the breaking weight of exactly similar briquettes, broken quickly and broken slowly. It is now generally recommended that the weight should be added at the rate of 100 lbs. in 15 seconds. Mr. Adie has devised an ingenious arrangement for regulating the speed of loading. Mr. Deacon, I believe, puts half the probable breaking weight on the briquette, and leaves it 12 hours, and then completes the test.

Tests by Compression.—Almost all that has been said thus far relates to the ordinary mode of testing

cements and cement mortars by tensile stress. That mode of testing was adopted for mere reasons of convenience. The cement has only about one-tenth the strength in tension which it has in compression. Hence, for tension tests a small, cheap, easily managed testing machine can be used. For compression tests, the testing machines must be much larger and more costly. But as a matter of fact cement is but little used in positions in which its resistance to tension is in play. The most important works in which cement is used are expressly designed to avoid tension in any part. If, indeed, in some positions structures are exposed to the possibility of tensile strains due to failure of foundations or backing, still the tensile stresses so developed are small compared with the normal crushing stresses for which the structure is designed.

Tension tests having been adopted, and being convenient, no doubt, find defenders. Broadly speaking a cement with high tenacity will be strong to resist crushing; but the correspondence in the resistance to the two kinds of stress is far from exact. Bauschinger has found that the ratio of resistance to crushing to resistance to tension varies from 11 to 1 to 7 to 1, and that the order of merit for cements tried for tension is not the same as the order for crushing. It has even been said that crushing tests are useless and inaccurate. If they have proved so, it is only because the proper conditions of accurate testing have been neglected. In Bauschinger's tests of 5-inch cubes, the results are considerably more uniform than the tests of the same cements in small briquettes by tension.

In proper crushing experiments two conditions must be fulfilled, which have hitherto been too much neglected in crushing experiments. (1.) The faces of the block on which the crushing pressure acts must be plane parallel surfaces. (2.) The crushing pressure must be uniformly distributed on those surfaces.

In moulded blocks of cement or cement concrete the surfaces are hardly ever as parallel as is desirable. The surfaces are generally more or less rough, and more or less warped. I have found a very convenient and simple way of getting over this difficulty. By striking over the faces a thin layer of gypsum or parian cement, which sets immediately, perfectly plane and parallel faces can be obtained without in any way altering the strength of the block. Weak as these cements are, thin layers stand the crushing pressure perfectly.

To ensure the equal distribution of the crushing pressure on the faces it is only necessary, in a properly constructed testing machine, to interpose a spherical joint between the block and the face of the machine.

I have on the table some large blocks (9-inch cubes) crushed in this way.

Detection of Adulteration.—The means of detecting adulteration of cement have been examined by Drs. R. & W. Fresenius. Adulteration by lime is shown by too low a specific gravity, great loss by ignition, high alkalinity of aqueous solution, and too great absorption of carbonic anhydride. An adulteration by slag is shown by slightly lowered specific gravity, lowered alkalinity, and by the large amount of chameleon solution which may be added. The details of the methods of testing are given in a paper abstracted recently for the Institute of Civil Engineers.*

I have now only to thank you for the attention you have given to this lecture, and sum up the general drift of the lecture in a conclusion which has already been urged with much force by Prof. Bauschinger. No other experimenter has had greater experience, or

has carried into the work of mechanical testing greater scientific knowledge. For ordinary testing of cement the ordinary methods must suffice. They serve their purpose well, they cost little, and in the time available for such tests they are the best to adopt. But for the full determination of the relative value of different cements, for the determination of the resistance of cement in the conditions in which it is actually used, experiments on a larger scale, with more costly apparatus, and extending over a longer interval of time, have now become necessary.

DISCUSSION.

The CHAIRMAN, in inviting discussion, said they had to thank Professor Unwin for a paper which, although not strictly on chemical lines, was a very useful paper, which showed the necessity they all felt for physical methods of investigation as applied to many practical operations which they had to carry on.

Mr. MUMFORD said he had had occasion to make some experiments with cement in clinker, and it appeared to him that when ground down into cement it was necessary that it should be of the same chemical composition as the clinker, and it occurred to him that the diagram showing the weight per cubic foot required some further explanation. Seeing the different weight per cubic foot of cement according to the fineness of grinding, it appeared to him that probably the coarser portion which was left behind on the sieve consisted of the harder constituents of the clinker, and were probably of different chemical composition, and probably contained more silicious matter. He had passed cement through a machine which gradually reduced the clinker to powder, and he found on eliminating the fine from the coarse in the first process he got a very large proportion of lime and a small proportion of silica, and he then took that part which would not pass through the sieve, reduced that to the same degree of fineness as that which came off in the first operation, and then thoroughly intermixed the two, and having sent them to a cement manufacturer who submitted them to very severe tests, he found that that which came off first—the softer portion, as he considered—would bear scarcely any strain. The more silicious particles when reduced to powder would bear a little more strain, but when a mixture of the two was formed, a very good cement was made. He should like to know if cement which weighed seventy-five pounds to the cubic foot would bear the same strain, and was of the same composition as that which weighed ninety pounds?

A MEMBER said he had long acquaintance with Portland cement, which at one time was not considered genuine unless it had a "blue" shade. Other and wiser tests were happily now applied and requisite. He was curious to know whether the common salt which was in the Medway mud was an essential constituent? If so, was salt used in any proportion in the production of cement from materials inland?

Mr. W. CROWDER said he had purchased considerable quantities of cement, and for want of better he applied the sieve test. He quite agreed that cement should be as finely ground as possible, since the coarse particles of genuine cement practically acted as so much sand and were diluents. He would be glad to know what was the standard sieve for cement, but since machinery had now been so much improved, he saw no reason why the 100-mesh sieve should not be taken as a standard.

Mr. A. E. FLETCHER thought the value of the principle of examination or testing had, in the case of cements, been eminently useful. By the use of the machine before them, contractors had a reliable test.

He asked if the expansion of cements varied according to the proportions of sand and cement?

Mr. BERNAYS said he had had a little experience in the use of cement, and could appreciate the difficulty on applying a proper amount of water. In testing small briquettes one inch square, he found after a month some of the ordinary modern cements bore over 600 pounds per square inch, but that was only after they had got some experience as to the proper amount of water. At first they used thirty per cent., and could not get it to set at all; the briquettes would lie sometimes a week without getting hard, but by gradually reducing the water to about twenty per cent. they found they had an excellent cement. They were using one of Mr. P. Adie's machines, which was exceedingly ingenious and simple, and gave a good result; the only difficulty he found was at the point where the two hooks grasped the briquette; unless they were very carefully centered and kept vertical the result varied very much. If some alteration could be made in the machine in that respect it would be an advantage. At present you might have two briquettes taken from the same mould on the same day, one bearing, perhaps, 200 pounds more pressure than the other, simply from the difference in the mode of grasping. The question raised by Mr. Mumford seemed a very pertinent one, and he had no doubt the difference in the strength of cement when sifted and unsifted had something to do with its chemical character, as well as with the mere size of the grains. He could quite understand that in grinding, the hard particles being at the same time chemically different would be less affected than the soft ones, and remaining behind on the sieve the chemical composition of the cement under test was altered. After cement had been passed through the sieve, the coarse particles should be re-ground and mixed with the rest.

Mr. WALLACE (Glasgow) said he had occasion to make a number of tests of Portland cement, sent to him to find out why they were defective. He had invariably found that analysis led to very little if any result, but when he sifted them the discovery was made that in all the bad samples there was too large a proportion of coarse particles. His experience agreed with that of Mr. Lees of the Clyde Navigation, who had used many thousands of tons, and tested it regularly. The average cement should not contain more than fifteen per cent. which would not pass through a 60-mesh sieve, and seventy per cent. of it should pass through a sieve of 90 meshes to the inch. His experience was simply this, that chemical analysis was of little use, but that sieving and practical tests such as those which had been referred to were those which should be made. The testing of neat cement was of little value, because cement was never so used practically. With regard to sand, there was no doubt that practice had pointed out that coarse sharp sand was the best, simply because there was a less extent of surface to cover. The reason why Portland cement so rapidly supplanted Roman was because it set so much slower, and so gave time for a thorough mixing of the water and sand. The Portland cement improved in quality the older it became. The previous speaker had anticipated a question which he was going to put, whether the experiments in the glass cylinder were made with neat cement, or cement and sand? Because, of course, sand had a marked effect in diminishing the expansion.

Professor UNWIN, in reply, said the first point raised was whether the apparent variation of density was due to segregation of the materials by sifting? To a limited extent that might be so, and his own impression was that probably the harder and better

burnt clinkers chiefly made the coarser particles, and to that cause part of the variation would be due; but there was a much greater variation of density than could be explained in that way, and it was mainly due to mere difference of packing. The other point raised was as to the expansion of Portland cement. Until lately the real facts had not been at all known, and they were only now known through some exceedingly delicate and beautiful measurements by Bausehinger. He had found that all good Portland cements hardened under water slightly expanded, and they expanded more when gauged neat and not mixed with sand. The expansion went on for a long time, but was extremely small, .05 of a millimetre in 120 millimetres as a maximum. It was only by some rather delicate test like the lamp glasses exhibited that this expansion could be made obvious.



NOTE ON SO-CALLED "PANCLASTITE."

BY H. SPRENGEL, PH.D., F.R.S.

IN "Notice sur la Panclastite, etc., 'par' Eugène Turpin, Paris, E. Bernard & Cie., 1882," we read:—

P. 11.—"PANCLASTITE. (Brise tout :—de : *παν*, tout; *κλαω*, je brise.) Explosifs à base de peroxyde d'azote.

"Principe découvert par Eug. Turpin (1878 à 1882).

"Le corps comburant est le peroxyde d'azote pur et anhydre à l'état liquide.

"Cette section a cela de tout à fait remarquable, c'est qu'aucun des produits qui entrent dans la composition des nombreux explosifs qui en font partie n'a jamais été employé à la confection d'un autre mélange détonant. Le comburant ou les combustibles n'ont jamais été appliqués, en aucun cas, dans ce but, soit ensemble, soit séparément, tandis que dans les 1re, 2e et 4e sections on retrouve le soufre et le charbon.

"Recherchant de suite toute ce que pouvait lui donner la découverte de ce nouveau principe, M. Turpin est parvenu à produire plus de cent explosifs nouveaux, c'est-à-dire un nombre plus considérable que celui qui comprend tous les explosifs connus antérieurement."

P. 5.—"La Panclastite est dans ce dernier cas. Découverte par M. Eugène Turpin, elle constitue une invention de principe qu'il ne faut pas confondre avec une invention reposant sur des principes connus, ce qui est le cas de la dynamite; les inventions de principe sont extrêmement rares et tendent à diminuer encore au fur et à mesure que le progrès se développe, tandis que les inventions d'application ou de perfectionnement augmentent constamment."

On this "invention de principe" Sir Frederiek Abel, in his Presidential Address at the annual meeting of the Society of Chemical Industry, July 11, 1883 (vol. ii. p. 313), kindly expresses himself thus:—

"Sprengel urged that the facts brought forward by him were susceptible of important application, because powerful explosive cartridges or charges might at any time be rapidly prepared from two ingredients which, kept separately, are non-explosive. The suggestion to deal, in mining or military operations, with highly-corrosive and more or less volatile liquids, upon the extensive scale which would be necessary if Sprengel's system were turned to practical account, has not commended itself to those experienced in such matters; but attention has quite recently been directed to the subject by a M. Eugène Turpin, who puts forward as an invention of his own what he calls a new series of explosives, which he has christened 'Panclastite,' but which are actually Sprengel's explosive mixtures. In his memoir of 1873, Sprengel gives a table of the total percentages of oxygen, and the percentages of available oxygen, in a great number of oxidising agents, and the superiority of monohydrate of nitric acid over the majority in the

latter respect is there shown. Turpin uses, or says he uses, anhydrous nitrogen peroxide as the oxidising agent in his Panclastite series, together with carbon bisulphite or nitro products of hydrocarbons. He therefore carries out Sprengel's suggestions, selecting for the purpose an oxidising agent of comparatively costly and inconvenient nature, and certainly not superior in oxidising power to the strongest commercial nitric acid. The publication in France of researches or inventions as original, the results or description of which have long been published in England, is an occurrence to which we are not unaccustomed, and so the performances of Sprengel's offspring, furnished by M. Turpin with an impressive family name, are exhibited at Chatou-Rueil, near Saint Germain, with much flourish of trumpets, and have recently been officially reported upon by a Royal Engineer officer as marvels of novelty and of explosive power."

Though it may appear to be somewhat late to refer at this time to the foregoing comments on my paper in the *Journal of the Chemical Society* of August, 1873, I hope that the importance which this matter promises to attain will excuse and justify the following note:—

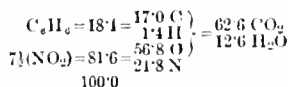
Note.—The "bean idéal" of a detonating explosive is a mixture of 8 parts (88.9 per cent.) of liquid oxygen and 1 part (11.1 per cent.) of liquid hydrogen.

In my paper of 1873 I say (page 799):—"On referring to the foregoing table the reader will be reminded that peroxide of hydrogen is the highest oxygen compound known, while nitric anhydride is the compound which contains the largest amount of oxygen available for combustion (74 per cent.). But as this compound, as well as the next two, nitric peroxide (69.5 per cent. oxygen) and tetranitromethane (65.3 per cent. oxygen) are, at present, on account of their nature and their difficult preparation, mere chemical curiosities, my attention naturally turned to the fourth, to *nitric acid* (63.5 per cent. oxygen), which is a cheap and common article of commerce."

Now, when M. Turpin's attention turned to the second oxidiser on my list—to nitric peroxide—he found that this substance does *not corrode* metals, such as iron, copper, and tin under 356° F. (180° C.); and further, that combustible liquids, such as petroleum, carbon bisulphide, and nitrobenzene are readily soluble in nitric peroxide *without* rise of temperature. These are valuable properties, *first noticed by M. Turpin*.

What was formerly a chemical curiosity is now an article of commerce. Nitric peroxide may be bought to-day at eighteen-pence the pound, and I see ways and means of producing it a great deal more cheaply. Nitric peroxide is a yellowish liquid, heavier than water (sp. gr.=1.451) and boils at 71° F. (22° C.), but may be kept like ether or similar volatile liquids. In France it is sent about in tinned-iron cans.

Taking as a typical example a benzene mixture



we see that the 18.4 parts of benzene require 56.8 parts of oxygen for the oxidation of their carbon and hydrogen to carbonic acid and water. This oxidation or combustion takes place at the moment of explosion at the expense of the 56.8 parts of oxygen contained in the rest of the mixture—the 81.6 parts of nitric peroxide. No other explosive now in use (including blasting gelatin) contains weight for weight a greater amount of combustible matter, and as an explosion of *these* bodies is simply a sudden combustion, I again beg to draw attention to the fact

that the oxygen available for combustion in gun-cotton is most probably not more than 32.3 per cent., and in nitro-glycerin 42.3 per cent.,* while in this case we have, without a doubt, 56.8 per cent. Hence no other explosive now in use can rival this and similar mixtures in power, as I published in 1873. They still remain *the most powerful* explosives known.

It hardly need be said that an explosive of this nature consists of two parts—an oxidising and a combustible agent,—and that M. Turpin with the same *naïveté* lays claim not only to the first, but also to the latter half of the subject.

None of my *safety*-explosives are licensed in England, though many of them, when mixed, are much less sensitive to concussion than common gunpowder.

Liverpool Section.

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Vice-Chairman: Dr. F. Hurter.

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Local Secretary and Treasurer: W. P. Thompson 6, Lord Street, Liverpool.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held Wednesday, March 3, 1886, at University College, Ashton Street.

THE PRESIDENT IN THE CHAIR.

COTTON-SEED OIL: ITS COLOURING MATTER AND MUCILAGE, AND DESCRIPTION OF A NEW METHOD OF RECOVERING THE LOSS OCCURRING IN THE REFINING PROCESS.

BY JAMES LONGMORE.

THE uses of cotton seed form a rapidly increasing industry, and the imports into the United Kingdom in 1885 reached 275,000 tons. The manufacture in the United States is probably ten times that amount, and considerable quantities are crushed on the Continent.

The oil expressed from the seed, when refined, is largely used for edible and soap-making purposes.

Crude cotton-seed oil is of an intense ruby, nearly black colour, due to its holding in solution a powerful vegetable colouring principle. This peculiarity distinguishes it from all other oils. The oil-cells appear in the seed as brown specks dispersed through the albuminous matter.

Until the present refining process was discovered, the crude oil was practically useless for commercial purposes, as it communicated a powerful stain, due to the colouring matter it contained. This latter, according to results obtained by the author, amounts to 10 to 15lb. per ton of oil; the proportion, however, varies considerably. The woody husk of the seed also contains a large quantity of apparently the same nature.

This colouring matter has now been isolated by the author, with the result of throwing some light upon

* Of these, by-the-by, only 33.8 per cent. can be utilised for want of fuel, as pointed out by me in my patent of 1871, and verified four years later by the force of Nobel's blasting gelatin, in which the excess of 3.32 per cent. of oxygen is utilised by the dissolved gun-cotton, an explosive too rich in carbon.

its nature. In its dry state it is a light powder of pungent odour, of a brown earthy colour, and possessing powerful dyeing properties. A small proportion of it is soluble in water, but the principal bulk dissolves only in alcohol or alkalis, and it is upon the latter property that the success of the present refining process, and the method now proposed for treating the mucilage, is dependent. It is quite insoluble in all acids.

The following is a description of the method of expression and refining of the crude oil universally adopted in this country :—

The seed is first crushed by passing through rollers, and then ground to a fine state of division under edge-runners. When sufficiently reduced it is transferred to steam-jacketed kettles, and heated for about 10 minutes to a temperature sufficient to render the oil more easily expressible, and to coagulate the albumen of the seed. To this operation the author draws special attention, as it will be shown to have an important bearing upon the question of recovering the oil from the mucilage. From the kettles, the finely-ground and heated seed is placed in bags, each making a cake weighing about 10lb., and subjected to powerful hydraulic pressure for 15 minutes. The crude, nearly black oil, containing all the colouring matter in solution, is by this means expressed, and runs into a tank, from which it is transferred to the refinery. The next step is to remove the colouring matter, the process bringing the oil to a light straw or yellow colour.

This is effected in the method now in use, by treating the crude oil with about 10 to 15 per cent of caustic soda lye of 10° to 12° Tw. This operation varies considerably, but merely as to the quantity and strength of lye used, some refiners using a greater strength than that given, and less quantity. The quality of the oil governs this to a great extent, old oil requiring more lye than new, etc. A lye as strong as 40° Tw. is often used; within that limit the variation is almost purely a matter of choice, but the application is in all cases the same. The refining vessel used is an ordinary iron tank, but should be of fair depth. To a charge of 10 tons of crude oil, about 30 cwt. of caustic soda lye of 10° to 12° Tw. will be required. The lye, after preparation, is allowed to cool down to about 60° F., and the oil is refined cold. The tank is provided with a mechanical agitator, and the operation commences by a brisk agitation of the oil, which is maintained to the end. For this purpose air, instead of the agitator, driven by a pump through perforated pipes laid in the bottom of the tank, is often used; this action, though good, has a tendency, the author finds, to oxidise a portion of the oil, which becomes pure loss; and a considerable quantity of oxidised acid oil will often be found on analysis in the mucilage. The agitation by either of these methods being continued, the soda lye is allowed to run slowly and gradually into the oil through perforated pipes extending over the surface of the tank, so as to give an equal distribution. As the agitation proceeds the lye and oil mix, and the oil now gradually becomes full of black flocculent particles of soap, caused by the partial saponification of a portion of the oil by the caustic soda lye. The agitation is continued for about half-an-hour, and if, at the end of that time, a portion is taken out and allowed to stand, the soapy particles will be found to precipitate from the oil, which, if then nearly deprived of colour, the operation is finished; if not sufficiently free from colour, more lye must be added, and the agitation continued until the desired degree of whiteness is obtained. The charge of oil, after this operation is completed, is then allowed to stand for 12 to 15 hours, or until the

"mucilage," or partially-saponified portion of the oil with the liquid excess of lye used, has precipitated. If a strong lye has been used, this mucilage will be solid, but if weak lye is used, the soap will dissolve as formed in the excess of liquid, and the mucilage be sufficiently fluid to run. As soon as the mucilage has entirely precipitated, the clear refined oil is run off from the sediment, and the refining completed by the subsequent operations of washing and bleaching. The quantity of lye used is sufficient to saponify about 7½ per cent. of the oil, and a charge of 10 tons will be found to lose on the average about 15wt. by the operation. The loss, however, is not always the same, and varies with the quality and description of the oil used from 4 to 10 per cent.

The success of this process is evidently due to the property the colouring matter possesses of solubility in alkalis, the greater affinity of which removes the former from the oil. Unfortunately, however, the caustic soda used as a solvent produces an inevitable saponification of a portion of the oil, which is thus lost, and the alkali is also thus rapidly neutralised, and a larger quantity required than would otherwise be the case. The particles of soap, however, seem to be sufficiently alkaline at the moment of formation to enclose within them the colouring matter, which is thus precipitated from the rest of the oil. It is this principle of solubility in alkali, which the author, having ascertained, has carried further, and applied to the mucilage itself, thereby in turn refining it.

The crude oil contains a considerable quantity of free stearine, and this is more especially the case when the oil has been allowed to stand any time before refining; this free stearine is the first attacked by the lye in the refining process, and all goes into the mucilage, the grease in which is, therefore, of much better quality or "body" than the refined oil itself, but containing, in a condensed condition, all the colouring matter of the crude oil.

It would therefore appear, from the explanation of the process of refining the crude oil, just given, that "mucilage" is simply partially-made soap in the first stage of preparation, that might be readily made into finished soap by ordinary methods, but containing a large quantity of vegetable colouring matter unfitting it for industrial purposes. For some reason, however, not previously discovered, which has hitherto baffled all attempts to use it for the purpose, the mucilage has not been convertible into true soap, nor has it been found possible to sufficiently free it from the colouring matter. The mucilage has, therefore, always been sold at a nominal figure to grease distillers for manufacture into stearine—chiefly employed in inferior candles, and the adulteration of tallow. The portion of oil saponified in the refining process is, therefore, practically at present almost pure loss to the refiner. It is this loss which, in the form of mucilage, the author has made the subject of investigation. As a result, he gives the methods to be described for regenerating and recovering the oil hitherto lost, "as refined and decolourised fatty acids," the colouring matter being extracted for use as a dye. The fatty acids, as recovered, can be dissolved in the refined oil, or used direct for soap-making purposes. This amounts to practically refining cotton-seed oil without loss in weight.

The first methods employed by the author with mucilage were chiefly for the purpose of extracting the colouring matter it contained for use as a dye. The mucilage was dissolved in four or five times its weight of water, made strongly alkaline by the addition of caustic soda lye to effect the solution of the colouring matter. The resulting soap was then separated by the addition of common salt, and the excess lye, being strongly alkaline, retained a considerable por-

tion of the colouring matter in solution. By neutralising the excess lye with sulphuric acid, the colouring matter was precipitated, and then separated and dried. The soap obtained by this means was useless, always remained of a purple colour, which gave a strong stain, and on boiling upon a saline solution, for the purpose of conversion into bar soap by the usual method, was converted into thick frothy scum, the curds of which did not coalesce upon becoming quiescent, and always remained mixed with more or less of the black lees. Care was taken that the solution of soap was not made so dilute as to cause the soap, on separation, to be precipitated as a di-stearate of the alkali, which would be afterwards inconvertible into true soap, and there was no apparent reason why the oil of the mucilage should thus work differently from other cotton oil, and refuse to make soap. This was, however, the result that has always attended more or less the efforts to utilise mucilage for soap. The author found that the use of salt as a separant was largely the cause of the effects experienced, that it tended to reduce the solubility of the colouring matter, thus preventing its removal, altered it from its natural colour of yellow to a disagreeable blackish purple, and for a reason afterwards discovered and to be described, produced the frothy character of the soap.

A greatly improved result was obtained, therefore, by entirely substituting caustic soda lye for common salt as a separant. By this means a perfectly clear soap of smooth close texture and good weight was obtained, and the great solvent power of the caustic soda lye sufficiently decolourised it for dyers' use. The soap obtained by this method, when freshly cut, was of a light yellow colour, and perfectly transparent, the exposed surface rapidly oxidising to a brown. The blackish purple colour, always the result of the use of salt, was avoided, and the soap gave no stain. It usually contains about 50 per cent. fatty acids; if required more concentrated, it must be boiled upon salt after decolourisation.

It was by this means possible to convert mucilage to good soap, and the author next turned his attention to producing from it refined fatty acids, which should be completely decolourised, and equal to ordinary refined oil. This further improvement was effected in one method by dissolving the brown soap obtained as described, and mixing with it 20 to 25 per cent. of an inert powder, such as finely-ground chalk, etc. On the addition of strong caustic lye, the soap precipitated very curiously with the chalk in a very minute division, and the remaining colouring matter of the soap dissolved in the excess lye. The completely decolourised fatty acids were liberated from the mixture by sulphuric acid. Another method consisted of boiling the solution of brown soap, made strongly alkaline, with 10 to 15 per cent. powdered peroxide of manganese or hydrated peroxide; on adding dilute sulphuric or hydrochloric acid the fatty acids as liberated were bleached.

Both these methods were superseded by the plan of bleaching the brown soap with calcium hypochlorite or bleaching powder, this improvement satisfactorily completing the methods of conversion of mucilage into refined acid oil. The detail of these methods is as follows:—

The raw mucilage, say in charges of 5 to 10 tons, is heated by open or close steam in a lead-lined tank to a temperature not exceeding 110° to 120° F.; dilute sulphuric acid is then added in small quantities gradually to avoid frothing, the charge after each addition being well agitated, and this is continued until the mucilage is completely decomposed. The charge must be kept neutral, and no excess of acid used. With excess of acid and great heat, the colour-

ing matter is affected and injured, and the alteration it undergoes renders its removal from the soap less easy. When the decomposition is complete—but the charge being quite neutral—the temperature is raised until the separated fatty acids are thoroughly melted, a few minutes being usually sufficient. The whole is then allowed to stand until the perfectly black fatty acids have collected on the surface. The useless saline liquor is run off. The acid oil so obtained, when cold, is of fairly solid consistence, and by analysis usually tests:—

80 per cent.	actual fatty acids.
1t	water.
9	colouring matter.
100	

Its retention of so much water is probably due to the strong hygroscopic nature of the colouring matter.

This acid oil is saponified with caustic soda lye in an ordinary soap copper, close steam being used. To every hundredweight of actual fatty acids present is added, when melted, the proportion of 152lb. of caustic soda lye of 17° Tw., and the whole boiled for a few minutes until the oil is saponified; this takes place very rapidly, the oil being fatty acids. The soap so formed, which will be nearly neutral, requires to be separated from the excess of liquid used. To effect this the boiling is continued, and 28lb. of lye of 70° Tw. in the same proportion gradually added in portions until the soap opens to a fairly strong curd, and is completely separated. The heat is now withdrawn, and the charge allowed to remain quiescent for one to two days; in that time the excess lyes completely precipitate, the curds of the soap coalesce, and a clear brown soap of good weight and close texture is the result. The excess lyes are drawn off, and the soap is then ready for bleaching.

In this process is clearly shown the effect of the solubility of the colouring matter in alkaline lyes. The solution of soap when boiling is of an intense black colour, but immediately on the addition of the strong lye of 70° Tw., the soap separates in curds of a bright reddish yellow colour, while the lyes remain intensely black. The separated soap being almost neutral, the strong alkaline lyes, by reason of their affinity for the colouring matter, have retained it in solution. So much is this the case that on cooling, the excess lyes often congeal to a consistence, through the presence of colouring matter, that allows of their being cut with a knife.

The operation that has been described of the extraction of the colouring matter by caustic soda, can be supplemented, if desired, by the ordinary operation of "fitting." To the brown soap remaining, after the black lees have been drawn off, sufficient water is added to dissolve and run the curds together, but no more, and the close soap then boiled for two or three hours, until the head or "fob" of froth has worked out; it is then left, if the charge is considerable—say 3 or 4 tons—for two days. In that time the excess of alkali, carrying with it a considerable quantity of colouring matter, and some portion of thin soap, subsides. This forms the "nigre," upon which floats a perfectly clear soap. From this the fob is skimmed off, and the nigre separated. This operation of fitting is not in any way essential, but by the further removal of colouring matter it economises the calcium hypochlorite in the succeeding bleaching process. Before proceeding to this latter, it may be well to consider the operations that have been described.

The preliminary decomposition of the mucilage by sulphuric acid into acid oil, is for the purpose of after economy in caustic soda, and is only necessary when

the raw mucilage contains so large a proportion of liquid, that to separate the soap from it by means of caustic soda would require a prohibitive amount of the latter. If the mucilage should contain as much as 30 to 40 per cent. of acid oil, the decomposition can be omitted with economy. For instance, to ensure the complete separation of the soap from its solution, it is usually necessary to bring the excess lyes to a strength of 18° to 20° Tw. The average quality of mucilage usually contains about 75 per cent. liquid, etc., and 25 per cent. acid oil. This makes only a thin solution of soap, and to separate the latter will require the addition, if treated direct, of 180 lb. of caustic soda lye of 70° Tw. per cwt. of fatty acids present. This quantity is allowing for the acid oil taking up its own weight of water to form soap, and the remaining excess lyes being of a strength of 20° Tw. The amount of caustic soda lye used, when the mucilage is previously decomposed, is only equivalent to 74 lb. of 70° Tw. per cwt. of oil, a saving of considerably more than one half, notwithstanding that this method necessitates the resaponification of the oil. The economy of this last process is due to the fact of acid oil being saponifiable in lye of any strength, whereas neutral oil is not saponifiable in lye exceeding a strength of 10° to 12° Tw., necessitating a large excess of liquid from which the soap has to be afterwards separated. The decomposition of the mucilage yielding the acid oil in a concentrated form, it can be resaponified in lye of great strength—70° Tw.—consequently the excess lyes can be regulated to any desired quantity, no more being used than is absolutely necessary for the soap to boil on without burning. The quantity of lye will always be sufficient for the solution of the colouring matter. The strength and quantity of the lye of 17° Tw. used is so regulated as to provide the alkali necessary to saponify the oil, sufficient water to form the soap, and also excess lyes of 20° Tw., which latter, with the after addition of the strong lye of 70° Tw., will amount to $\frac{2}{3}$ of the fatty acids, or $\frac{2}{3}$ of the soap in weight; this is allowing for the 11 per cent. of water contained in the acid oil. The proportion of excess lyes stated will usually be found sufficient with a suitable soap pan, and economy in this respect is of vital importance. Open steam should not be used, as the large amount of condensation reduces the strength of the lye, and necessitates a larger quantity.

All mucilage varies very much as to its proportions—from 60 to 85 per cent. of water,—and in the case of mucilage treated direct without decomposition, the quantity of lye named must be altered according to the percentage of water present. The additions of lye must be continued until the soap is judged to be well and sufficiently separated.

Although the caustic soda process that has been described removes the bulk of the colouring matter and deprives the soap of its staining power, the latter still remains of a brown colour that even repeated applications of the caustic soda lye will not remove, supposing such to be economically practicable. The complete decolourisation of the soap and acid oil is effected by bleaching with calcium hypochlorite.

The brown soap is melted in a lead-lined tank, with a small quantity of water, and boiled by means of open or close steam. While boiling, bleaching powder, made into a cream with water, is added gradually in portions, and the soap begins to bleach, assuming first a bright red colour. The reaction is very energetic, mutual decomposition ensuing, the chlorine uniting with the soda of the soap to form sodium chloride. The fatty acids thus liberated are completely bleached, precipitating as a white insoluble lime soap. Ten to fifteen per cent. of the

calcium hypochlorite will be requisite for complete decomposition of the soda soap; but the latter will often be sufficiently bleached when only partial decomposition has occurred. In such cases the amount of bleaching powder will be less; the additions must be gradually continued until the desired colour is attained. Strong solutions of the soap bleach more effectually than weak. The sodium chloride solution is run off, and the bleached lime soap, or mixed lime and soda soap, as the case may be, in turn decomposed into fatty acids and sulphate of lime, by boiling with dilute sulphuric acid. When the reaction is completed, the calcium sulphate and liquid are allowed to settle, and the hot melted fatty acids run or ladled into another vessel, where they are well washed with water to remove all excess of mineral acid.

The first attempts at bleaching with hypochlorites were made with the sodium salt, thus avoiding the decomposition of the soap. Sodium hypochlorite, however, on heating, is at once reduced to chlorate, consequently only a portion of the chlorine is available for bleaching. Moreover, the chlorate formed, immediately separates the soap, and on soap not in solution the bleaching action is very slight, only the surface being acted upon. With sodium hypochlorite, therefore, repeated applications of the salt would be requisite to fully bleach the soap; and as compared with the calcium salt, in which the whole of the chlorine is obtained in the most effective manner possible, and the bleaching rapid and complete, the expense and trouble of the former treatment would be prohibitive, and attempts in that direction may therefore be dismissed.

A reference has been made to the fact that mucilage had always been found to be inconvertible into true soap, the reason of which was unknown.

It has been seen that the substitution of soda lye for salt as a separant, removed the difficulty experienced so far as regarded decolourisation, and the light frothy character of the soap, and with much of the mucilage commercially available the process that has been described accomplished its conversion into refined acid oil. In the case of the major quantity of mucilage obtainable, the caustic soda treatment only presented the old difficulty of conversion into soap in a fresh form. This consisted of the impossibility of completely separating the soap from its solution. In all cases where this has occurred, the author has ascertained that the effect was due to the presence of albuminous matter in the mucilage, and that apart from the question of decolourisation, this was the reason of mucilage having been inconvertible into soap. In a sodium chloride solution the albuminous matter is insoluble, and the soap on separation therefore takes it up, acquiring the frothy character described. In an alkaline solution, the albumen is soluble, and remains in the excess lyes; the soap separated by means of strong caustic lye is therefore free from it; but a considerable portion of the soap remains in solution with the albumen, and cannot be extracted. The author has recently succeeded in meeting this difficulty by neutralising the albumen by means of lime. The due proportions of caustic soda lye are first added to the charge of mucilage, or of black acid oil, in the manner that has been detailed. If no albumen is present, all the soap will thereupon separate, and nothing further is necessary. But in exact proportion to the quantity of albumen that may be in the charge, a certain amount of soap will be retained in solution by it, a portion only separating on the addition of the lye; if the albumen be in sufficient amount all the soap will remain in solution. In such case, while the charge is boiling, milk of lime is added gradually in portions; the

albuminate of soda formed by the previous addition of the caustic soda lye is thereby decomposed, and an insoluble albuminate of lime precipitates. This being inert, the soap previously held in solution thereupon separates. The lime albuminate precipitates with the excess lyes, and the soap is ready for bleaching. The addition of lime must be continued until it is found that all the soap has separated from solution. The latter can be ascertained very simply by taking from the charge a small sample of the excess lye, and rapidly cooling it, or adding a little lime. If in either case soap separates, more lime must be added to the charge; this is always supposing that the non-separation is not due to insufficient soda lye. Care must be taken to use no excess of lime, which would decompose the soda soap.

The saponification and decolourisation by caustic soda lye; removal of albumen, if present, by lime; bleaching by calcium hypochlorite; and decomposition by mineral acid, completes the operations necessary for the conversion of mucilage to refined acid oil.

In dealing with mucilage, the effect that has been experienced of albumen on solutions of soap, is very curious. Ordinarily, soap is not soluble in soda solutions exceeding 1.060 to 1.070 specific gravity; but in instances where the excess lyes would have tested 1.350 specific gravity, the bulk of the soap still remained in solution. Exactly the same result is obtained by incorporating egg albumen or cotton-seed with tallow or other soap. Albumen therefore possesses the property of rendering soap soluble in alkaline solutions of any strength. If the albumen is present in a small proportion only, the bulk of the soap will separate on the addition of the lye, and the remainder on becoming quite cold; if the proportion of albumen be increased, less soap will separate, and so on until the whole of the soap remains soluble even upon cooling. Refined cotton-seed oil, saponified and dissolved with 25 to 30 per cent. of its weight of cotton-seed, is inseparable with any strength or proportion of lye. In the case of mucilage, the soap separated by cooling the excess lyes was not decolourised, nor could it afterwards be so. The quantity of soap separated can be increased by removing it as fast as it forms on boiling; the exposure of a fresh surface to the atmosphere apparently having the effect of causing a further separation. If, however, the soap so formed is allowed to remain quiescent on the lyes, it redissolves.

The albuminous matter in the mucilage is found to consist of the finer portions of the cotton-seed which are abstracted by the crude oil. In the process of refining, the albumen is dissolved by the caustic soda lye, and thus passes into the mucilage. The reactions which mark its presence are very distinguishable on decomposing the latter. Should the mucilage contain albuminous matter or cotton-seed, on treating it with sulphuric acid, the separated liquid will be of a bright yellow colour, which, on standing, gives a granular deposit of vegetable albumen. The larger quantity of the latter present in the mucilage will be taken up by the liberated acid oil; this, if the proportion of albumen be considerable, consequently acquires a tough plastic consistence, and is difficult to saponify. The mixture is often of greater specific gravity than water. If heated beyond a temperature of 120–130° F. it assumes an intense green colour, and soap made from it is the same. Below a temperature of 100–110° F. the colour is not affected. It is on this account of the greatest importance that in the case of albuminous mucilage, the temperature of the acid oil should not at any time previous to

saponification and the lime treatment be raised to a temperature exceeding that named, otherwise, owing to the colour assumed, it would become useless.

The reaction furnishes an infallible guide. If a sample of the black acid oil on heating beyond 130° F. turns green, lime will be required; if the colour remains unaltered, the caustic soda process alone is requisite. By dissolving the green acid oil in alcohol, a bright green solution is obtained; on filtration the albumen remains as a green insoluble residue. This method allows of the estimation of the albumen.

With the exception of its preventing the separation of the soap, the seed gives no special characteristics to the mucilage itself, and is not visible in it. This is probably the reason it has so long escaped detection.

Under the great hydraulic pressure to which the seed is subjected, much of the finer portion passes through the bags with the crude oil. If the latter is allowed to stand for a short time, the seed precipitates as a slinky deposit, and can be removed. It was attempted to adopt this method for the purpose of preventing the albumen passing into the mucilage, but without success. After carefully separating from a charge of oil, before it was refined, all the insoluble matter it contained, the mucilage was still found to hold so large a proportion of albuminous matter as to render it unworkable. The crude oil must therefore have had a considerable quantity of seed in solution, and this is a fact not hitherto suspected, and to which serious losses in weight of seed during crushing are probably due. A considerable percentage may thus escape undetected. This will be readily recognised, as mucilage containing 15–20%, and even 35 or 40% of hulled seed is often met with. One lot of 1000 tons of seed was found to have lost 5% in crushing, and the mucilage contained a large proportion of albuminous matter. In the mucilage it is of course worth nothing, only interfering with the recovery of the fatty acids, which are alone of value. On this account, and the serious losses due to the waste of seed, the matter is one for the attention of manufacturers, with a view to overcoming the difficulty, and preventing the escape of seed. The author offers the suggestion that the cause probably lies in the operation to which he drew attention—of heating the seed in the kettles. It is possible that the oil derives its power of dissolving the [seed from the latter having been imperfectly heated, and for too short a time and at too low a temperature to thoroughly coagulate the albumen.

If the colouring matter be not separated from the excess lyes, or it is more desirable to recover the soda, they can be evaporated to dryness and the soda calcined. The vegetable matter is thus destroyed, and by lixiviation the soda is ready after causticising for re-use. The strength of the lyes allows of this being economically done, and the cost of the process thus materially reduced. It requires an expenditure of less than four tons of fuel per ton of soda ash of 45° recovered.

The characteristics of the colouring matter have been described. Its preparation is effected by first filtering the excess lyes to remove from them all particles of soap that may not have been previously separated. To the clear solution thus obtained, dilute sulphuric acid is added gradually until the alkali is completely neutralised. The colouring matter then separates as a flocculent precipitate. This is collected on a filter, carefully washed to remove all excess of acid, and dried slowly at a low temperature. It is then ready for use as a dye, and gives perfectly fast colours on both wool and silk, resisting the action of light, acids, and alkalis.

To dye a direct colour—for a bath of ten pounds of woollen yarn—seven ounces of the dye, dissolved with seven ounces of carbonate of soda ($\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$) is used, boiling for three hours.

To produce in the ordinary manner a corresponding shade, requires—

5oz. Bichrome.
3oz. Cudbear.
3oz. Extract of Fustic.
 $\frac{1}{2}$ oz. Logwood.

Another method is to prepare the bath by dissolving the colouring matter with the requisite amount of alkali, and then precipitate it by neutralisation with sulphuric, hydrochloric, or acetic acid; if care be taken to use no excess of acid, the colouring matter remains in suspension in a very fine state of division. If an excess of acid be used it clots in particles too large to enter the fibres of the wool, and is useless. In a state of suspension, the colouring matter is taken up by the wool immediately, and the operation is much shorter than when used in solution. On the other hand, however, the wool is liable to be only surface dyed, and in the operation of scouring the shade will be much lightened.

In using solutions, no more alkali should be used than is absolutely necessary to dissolve the dye, as the attraction of the alkali neutralises the attraction of the wool for the colouring matter.

A richer shade is obtained by using wool previously mordanted in the usual manner by working in a bath of bichromate of potash; this deepens the shade, giving a warm brownish red.

The shades and colours can be varied to any extent by combinations with the other colouring matters.

With the whole range of aniline colours, the cotton-seed colouring matter seems to possess the property of forming definite chemical compounds, the nature of which is not yet fully investigated. These are formed by dissolving equal weights of the cotton-seed colouring matter and $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ in water. This is then strained, and to the solution so obtained is added a previously prepared solution of an aniline dye; the strength and quantity of the latter is governed by the nature of the shade required, which is a matter of choice. The whole is agitated until thoroughly mixed, and a weak solution of H_2SO_4 slowly poured in until the Na_2CO_3 is neutralised. The colouring matter precipitates, and is separated, washed and dried. The compound thus obtained is not decomposable by boiling water, it possesses the brilliancy of the aniline, but the characteristics of the vegetable colouring matter, being soluble only in alkalis and alcohol, and perfectly fast. The cotton-seed colouring matter acquires the colour of the aniline used, and only a small proportion of the latter is necessary. In this way an infinite variety of brilliant dyes of perfect fastness may be obtained.

The methods of dyeing silk are analogous to those already described for wool.

If the colouring matter is heated to boiling point with its own weight of $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$, and six times its weight of water, the whole being stirred until dissolved, it will on cooling set to a solid paste. In this form it is very readily soluble, and more convenient for dyeing purposes than the dry powder.

A slight drawback of the colouring matter has been found to be in a tendency to impart a faint feeling of harshness to the wool, unless the dyeing be carefully conducted. This may be a natural property of the dye, but is more likely, when it occurs, the result of the alkaline treatment it goes through in the process of preparation, and will probably yield to further investigation.

DISCUSSION.

Mr. GOSSAGE thought that English cotton-seed mucilage could hardly contain as much as twenty-five per cent. of oil. Judging from the difference between the prices of crude and refined cotton oil, the loss in refining could not be more than five per cent., and indeed was generally much less. The author had not given sufficient information to enable them to judge whether the colouring matter derived from the mucilage could be obtained at such a price as to make it a marketable commodity. That the mucilage sometimes contained a very large proportion of albumen, and that it could be separated by means of lime, were among the most interesting features of the paper.

The CHAIRMAN said he understood the author to say that the colouring matter referred to was very like tar, and also a good dye when isolated, and mixed with aniline dyes. If the meeting could hear something about the properties of this colouring matter, it would be useful. Was it not possible to get rid of the albumen by coagulating it before pressing the seed?

Mr. NORMAN TATE had listened attentively to the paper, but, although it gave many details of processes, he could not find in it anything particularly new. He was surprised to hear that in the mucilage so large an amount as twenty-five per cent. of oil remained, as this was very considerably above what was found in ordinary English mucilage. There were mucilages in commerce which contained as much as fifty per cent. of fatty matters, but these were exceptional, arising from some particular mode of expressing and treating the oil. The paper was useful as giving details of results obtained in certain experiments. Such records of failures and successes had their uses, but in his opinion there was nothing in the process which could supersede those now most generally in use. The Chairman had suggested the elimination of albuminous matters by coagulation. Heating the seed or oil might do it, but unless it were done with great care, the results might be neither economical nor salutary. He would like to have heard more about the colouring matter, as disadvantages arising from its use and discussions respecting it were constantly arising.

Mr. W. P. THOMPSON stated that he had seen small samples of cloth dyed by this material ranging in colour from a light straw colour to a rich dark brown. The dyestuff itself had an appearance between snuff and ground coffee, and had a strong pungent smell. He had on one occasion asked the author the very question suggested by the Chairman, as to whether they could not coagulate the albumen after expression of the oil; but, if he remembered rightly, the author had stated that heating the oil itself sufficiently to coagulate the albumen would injure both the oil and the dyestuff, while no result would be obtained by heating the mucilage, as the albuminate of soda would not coagulate.

Professor CAMPBELL BROWN said that he regretted the author's absence, because he might have been able to give them some of the experimental foundations for his rather large statement, that the colouring matter of the oil formed chemical compounds with nearly all aniline dyes. If one knew the nature of these compounds (if they existed) one would probably know the chemical nature of the colouring matter of the oil itself. The paper as a whole showed that a great amount of time and work had been spent on the investigation, much of it labour that might have been saved if the experiments had been carried on in a systematic and philosophical manner. For instance, if the composition of the specimens

used and of the products obtained had been ascertained at each stage, the author would have very soon arrived at the principal result—namely, the presence of the substance, whatever it was, which had been called albumen in the paper, and the necessity for its absence in order to obtain success. In this way all the intermediate stages of failure would have been avoided. The age of random experiment was now past, and practice must be guided by theoretical knowledge in order to attain success.

The CHAIRMAN regretted that the author was not present to answer the various questions which had been raised. What they wanted to know was whether the real colouring matter could be isolated, and whether it was capable of industrial application, the instances of silk dyeing cited seeming to have been only experimental.



Meeting held April 7, 1886.

COWLES' ALUMINIUM FURNACE.

BY W. P. THOMSON.

THE new departure in metallurgical science forming the subject-matter of this paper is the invention almost exclusively of Messrs. Eugene H. and Alfred H. Cowles, of Cleveland, Ohio, and is covered in this country by a series of five patents taken out by me as communications from them. This paper is mainly a compilation from data letters, reports, and extracts, kindly furnished by Messrs. Cowles and their European commercial agent, Mr. Ben. M. Plumb, for the most part unpublished as yet in this kingdom. That the invention is rightly termed a new departure must be acknowledged by every one, when they learn that chromium, titanium, silicon, aluminium, calcium, and the other alkaline earth metals are obtained by direct reduction of their oxides by means of carbon, till a year ago almost universally considered a practical impossibility. By this process aluminium can be produced upon a large commercial scale in its various alloys at a cost of two shillings per pound. The process has for some months been at work on a small manufacturing scale, and before describing it by aid of the accompanying diagrams, I will read the brief description by Mr. Eugene Cowles (given at the annual meeting of the Franklin Institute of Philadelphia, in January last) of the actual plant used for driving the electric furnace, the main feature of the invention.

The Dynamos.—These are, of course, placed in the dynamo-room, as near as possible to the driving-shaft, where they can be kept free from any dust or grit from the furnace-room. The larger of these is by far the most powerful machine ever built by the Brush Electric Company. It weighs over seven thousand pounds, and at a speed of 907 revolutions per minute produces a current of 1575 amperes, with an intensity of 46.7 volts. It is of the shunt-wound type of dynamo, built for the purpose of incandescent lighting; further than being of greater capacity, and having a hub made of the Cowles aluminium brass, which exhibited a tensile strength of 95,000 pounds per square inch and 5 per cent. elongation, this dynamo does not differ from the ordinary machine.

Conduction of the current of the large dynamo to the furnace in the furnace-room and back to the machine, is accomplished by a complete metallic circuit, except where it is broken by the interposition of carbon electrodes, and the mass of pulverised carbon in which the decomposition of the ore takes place. This circuit consists of thirteen copper wires,

each 0.3 inch in diameter. There is likewise inserted into this circuit an ampère meter through whose helix the entire current flows, indicating, by its suction of a plunger armature attached to a spring balance and dial-faced indicator, the total strength of current being used.

This ampere meter is an important element in the management of the furnace, as by the position of the finger on the dial the furnace attendant can tell to a nicety what is being done by the current within the furnace. It is placed upon a shelf in a good light, near to and in full view of a person in any position about the furnaces.

Between the ammeter and the furnace in the furnace-room, and forming part of the circuit, is placed a large resistance coil of German silver immersed in water, a heavy copper slide passing backwards or forwards as desired, throwing more or less of this resistance into the circuit, and almost the entire energy of the current may be thus applied to heating water. The object of the resistance box is to serve as a safety appliance. It is used by the furnace operator when it is desired to change the current from one furnace to another, or if it be necessary to choke off the current almost entirely before breaking it by a switch, thus preventing serious flashing at the commutator of the dynamo or at the switch. It is likewise of value should any evidence of a short circuit appear in the furnace or elsewhere.

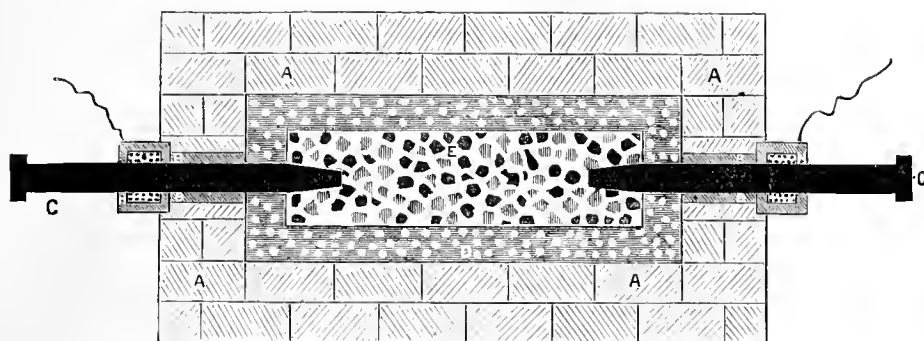
The furnace is simple in construction, being what might be called a rectangular box A, one foot wide, five feet long inside measurement, and fifteen inches deep, and made of fire-brick. From the opposite ends, through pipes B the two electrodes CC and holders pass. The electrodes are immense electric-light carbons, three inches in diameter, and thirty inches long. If larger electrodes be required, a series this size must be used instead, as so far all attempts that have been made to make carbons of larger size that will not disintegrate on becoming incandescent have failed. The ends of the carbons are placed within a few inches of each other, in the centre of the furnace. In the circuit between the furnace and dynamo is placed the resistance box and the ammeter. The resistance box is so constructed that a variable resistance may be thrown into the circuit, if such be desired in controlling the current. The ammeter was designed by Mr. Brush, and is so constructed as to take from fifty to two thousand amperes of current around its helices and register the same upon its dial.

These connections having been made, the furnace is now ready to receive the charge. The walls of the furnace must first be protected, otherwise the intense heat generated within the interior would cause the fire-brick to melt and flow like water. What is the best substance to line the walls with? Finely-powdered charcoal is comparatively a poor conductor of electricity. It is considered infusible, and is the best non-conductor of heat of all known solids. From these properties it would seem to be the best material to use as a lining for the furnace. So long as the air is excluded it is impossible for it to burn. But it is found after using pure charcoal for a few times that it becomes valueless. It retains its woody structure, as is shown in the larger pieces, but it has changed to graphite, becoming a good conductor of electricity, and thereby it tends to diffuse our current through the lining, heating it and the walls. The fine charcoal is therefore washed in a solution of lime water. After drying, each particle is insulated by a fine coating of lime. The bottom of the furnace is now lined to a depth of two or three inches with this prepared charcoal D. A sheet-iron gauge is placed

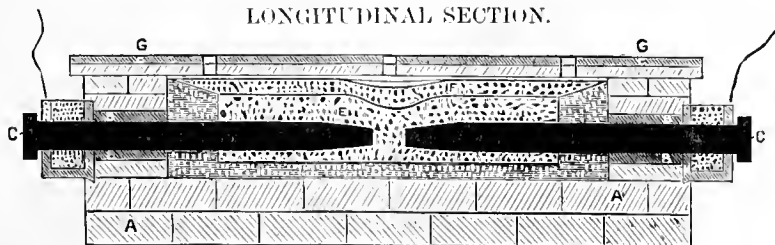
along the sides of the electrodes, leaving about two inches between it and the side walls. In this space more fine charcoal is placed. The charge E, consisting of about twenty-five pounds of the oxide of aluminium, twelve pounds of charcoal and carbon, and fifty pounds of granulated copper, is now placed within the gauge, and spread around the electrode to within a foot of each end of the furnace. In place of granulated copper, a series of short copper wires or bars can be placed parallel to each other and transverse to the furnace among the alumina and carbon.

in the plan annexed, and from this cause the internal resistance of the furnace may be too low for the dynamo and cause a short circuit. The operator therefore throws sufficient resistance within the circuit, by means of the resistance box (not shown) to make it safe to start the dynamo. This being done, he gradually takes the resistance of the box out of the circuit, and by watching the ammeter, and now and then moving one of the electrodes out a trifle, he is enabled to prevent undue short-circuiting in the beginning of the operation. In about ten minutes the copper between the electrodes has become melted,

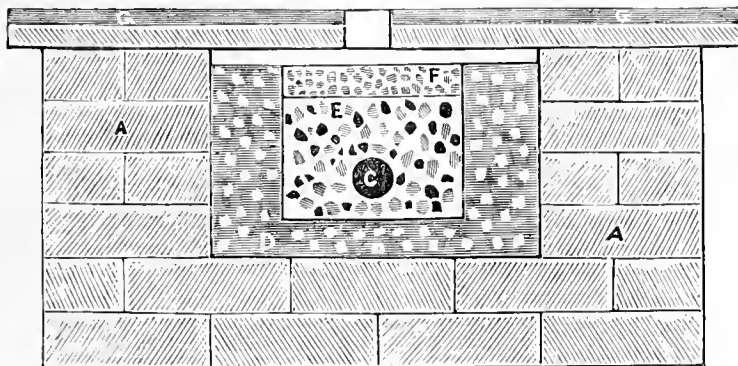
SECTIONAL PLAN.



LONGITUDINAL SECTION.



TRANSVERSE SECTION.



After this is done a bed of charcoal F, the granules of which vary in size from that of a chestnut to that of a hickory nut, is spread over the charge and the gauge withdrawn. This coarse bed of charcoal above the charge allows free escape for the carbonic oxide gas generated during the reduction. The charge being in place, an iron top G lined with fire-brick is placed over the whole furnace, and the crevice luted to prevent the entrance of air. The brick of the walls insulate this cover from the current.

Now that the furnace is charged and the cover luted down, it is started. The ends of the electrodes were in the beginning placed close together, as shown

and the latter are moved far enough apart so that the current becomes steady. The current is now allowed to increase till about thirteen hundred amperes are being drawn from the dynamo, driven by fifty volts. Carbonic oxide gas has already commenced escaping through the two orifices in the top, where it burns with a white flame. By slight movements outward of the electrodes during the coming five hours, the internal resistance of the furnace is kept constant, and at the same time all the different parts of the charge are brought in turn into the zone of reduction. At the close of the run the electrodes are in the position shown in the accompanying elevation, the

furnace is shut down by placing a resistance in the box, and then the current is switched into another furnace, which has been charged in a like manner.

This regulating of the furnace by hand is rather costly and unsatisfactory. Several experiments have therefore been tried for making it self-regulating, and on the 26th of January last, a British patent was applied for by Messrs. Cowles, covering an arrangement for operating the electrodes by means of a shunt circuit, electro magnet and vibrating armature. If the electrodes were drawn back and exposed to the air in their highly-heated state, they would be rapidly wasted away. To obviate this, Messrs. Cowles place what might be called a stuffing box round them, consisting of a copper box filled with copper shot. Copper, on account of its well-known properties of conducting heat and electricity, is preferable in most cases to other substances for this purpose. The wires are attached to the boxes instead of direct to the electrodes. The hot electrodes, as they emerge from the furnace, first encounter the shot, which rapidly carries off the heat, and by the time they emerge from the box they are too cool to be oxidised by contact with air.

During one operation of five hours required for the above-mentioned charge, there has been, one might say, pumped into the furnace ninety electrical horse-power, which, if it were devoted to heating the fifty pounds of copper alone contained within the furnace, would raise it to a temperature of two hundred and forty-two thousand degrees Fahrenheit, were such a thing possible. During the beginning of the operation, the copper first melted in the centre of the furnace. There was no escape for the heat that was continually generated. The temperature increased till the refractory corundum melted, and, being surrounded on all sides by carbon, gave up its oxygen. The heat of the union of the oxygen liberated from the aluminium uniting with the carbon, has certainly aided in the economy of the process. The copper has had nothing to do with the reaction, as it will take place in its absence.

Whether the reduction is due to the intense heat, to electrolytic action, or both, is difficult to say. If it be electrolysis, it is Mr. Cowles' impression that we have here a case where electrolysis can be accomplished with an alternating current, although it has not been tried as yet. Were the copper absent, the freed aluminium would now absorb carbon and become a yellow crystalline carburet of aluminium; but, instead of that, the copper has become a boiling, seething mass, and the bubbling of its vapours may be distinctly heard. The vapours probably rise an inch or two, condense, and fall back, carrying with them the freed aluminium. This continues until the current is taken off from the furnace, when we have the copper charged with from fifteen to thirty per cent., and in some cases as high as forty per cent. of its weight of aluminium, and a little silicon. After cooling the furnace, this rich alloy of aluminium and copper is removed.

Another valuable property of the fine charcoal is that the metal does not spread and run through its interstices, but remains a liquid mass surrounded below and on the sides by fine charcoal, the fine charcoal sustaining it just as fine flour or other dust will sustain drops of water for considerable periods without allowing them to sink in. The alloy presents a white appearance and the brittle nature of the sample I have in my hand. This metal is now melted in an ordinary crucible furnace, poured into large ingots, and the amount of aluminium it contains is determined by analysis, after which it is again melted, and the requisite copper added to make the valuable aluminium bronzes, of which I will speak later.

Two runs, as described, will produce in ten hours' average work, about one hundred pounds of this white metal, containing about fifteen pounds of aluminium. From this data it has been carefully estimated that aluminium itself, in its alloys, can be produced at about forty cents. a pound in the works now being erected by the Cowles Electric Smelting and Aluminium Company, at Lockport, New York. This estimate is based upon the present size and form of furnace.

The Cowles Electric Smelting and Aluminium Company will shortly have facilities for concentrating within one furnace the energy of twelve hundred horse-power. With a larger furnace, there is no reason why it should not be made to run continuously like the ordinary blast furnace.

The temperature attainable within the furnace is only limited by the fusion point of carbon; as yet we have not reached this limit. The charcoal is easily changed to graphite, but so far it has always retained its woody structure.

Pure white sand is not only made to melt, but is easily reduced to silicon. A mass of minute crystals of silicon was obtained from a fire-brick being placed within the furnace and too near the centre of heat. The other elements that were present seem to have volatilised, leaving nothing but the silicon behind.

Boron, sodium, potassium, calcium, magnesium, chromium, and titanium have all been reduced from their oxides by means of carbon in the furnace. It is safe to say that no metallic oxide can resist the intense reducing forces that are here brought to bear upon it.

In the operation of the furnace, copper was used to gather the aluminium together, and prevent its formation into carburet of aluminium, or into amorphous powder. The copper acts somewhat as a condenser to the metallic fumes of aluminium liberated. In place of the copper, any non-volatile metal may be used as a condenser, to unite with any metal it may be desired to reduce; provided, of course, the two metals are of such a nature that they will alloy with each other at this high temperature. In this way, aluminium may be produced and obtained, alloyed with iron, nickel silver, tin, or cobalt. Messrs. Cowles have made alloys containing 50 per cent. of aluminium and 50 per cent. of iron; 25 per cent. of aluminium and 75 per cent. of nickel; 30 per cent. of aluminium and 70 per cent. of copper. I have here some of these alloys. Silicon or boron, or other rare metals, may be combined in the same manner, or tertiary alloys may be produced—as, for instance, when fire clay is reduced in the presence of copper we obtain an alloy of silicon, aluminium and copper. This is a white, brittle alloy when more than ten per cent. of aluminium and silicon is present in the copper. With from two to six per cent. of aluminium and silicon in equal proportions, the alloy is stronger than gun-metal, has great toughness, does not oxidise when heated in the air, and has fine variations of yellow gold colour.

The alloys which the metals obtained by the methods above described form with copper, have been made the subject of careful study. An alloy, containing 10 per cent. of aluminium and 90 per cent. of copper, forms the so-called aluminium bronze, with a fine golden colour, which it retains for all time. The 5 per cent. aluminium alloy is a close approximation in colour to 18 gold, and does not tarnish readily. Its tensile strength in the form of casting is equivalent to a strain of 68,000 pounds to the square inch. An alloy, containing 2 or 3 per cent. aluminium, is stronger than brass, possesses greater permanency of colour, and would make an excellent substitute for that metal. When the percentage of aluminium reaches 13, an exceedingly hard, brittle alloy of a

reddish colour is obtained, and higher percentages increase the brittleness, and the colour becomes greyish black. Above 25 per cent. the strength again increases.

The effect of silicon in small proportions upon copper and aluminium bronze is to greatly increase its tensile strength. When more than 5 per cent. is present the product is exceedingly brittle, and greyish black in colour. It is probable that silicon acts to a certain extent as a fluxing material upon the oxides present in the copper, thereby making the metal more homogeneous. On account of its superior strength and high conductivity for electrical currents, silicon bronze is the best material known for telegraph and telephone wire, and is now in large use on the Continent for this purpose, its conductivity being almost the same as and its tensile strength being double that of copper.

The element boron seems to have almost as marked an effect upon copper as carbon does upon iron. A small percentage in copper increases its strength to 50,000 or 60,000 pounds per square inch without diminishing to any extent its conductivity.

Aluminium seems to increase very considerably the strength of all metals with which it is alloyed. An alloy of copper, nickel, and zinc, containing a small percentage of aluminium, called Hercules metal, withstood a strain of 105,000 pounds, and broke without elongation. The knife I hold in my hand is made of this alloy. Another grade of this metal broke under an ultimate strain of 111,000 pounds with elongation equivalent to 33 per cent. It must be remembered that these tests were all made upon castings of the alloys. The strength of common brass is doubled by the addition of 2 or 3 per cent. of aluminium. Alloys of aluminium and iron are obtained without difficulty; one product was analysed containing 40 per cent. of aluminium. In the furnace iron does not seem to be absorbed readily by the reduced aluminium when copper is present; but in one experiment a mixture, composed of old files 60 per cent., nickel 5 per cent., and of "10 per cent. aluminium bronze" 35 per cent., was melted together, and it gave a malleable product that stood a strain of 69,000 pounds.

I have here a miniature anvil made of another alloy in imitation of silver; the colour is perfect, but it differs from silver in being untarnishable and very hard though tough.

This alloy is composed of aluminium, nickel and copper, as in the case of "Hercules metal," or aluminium added to German silver, and is now coming into use in America for plumbers' faucets and table knives. These latter will take any edge and hold it even to the cutting a hickory stick. I will now hand round a formidable bowie knife made from this metal. The great advantage of this metal is that it will maintain its beautiful white lustre for all time, and permits of objects being made from it like plumbers' goods and all plated ware, in an enduring and substantial manner. It requires no plating of any kind.

An aluminium and silicon bronze wire of metal made at Messrs. Cowles' works, has, I have just heard in a letter to-day, stood a testing strain of 200,000 pounds to the square inch before breaking, a tensile strength hitherto utterly unprecedented in any material.

Hitherto I have spoken of alloys of aluminium, as the experiments thus far tried to make the pure metal by this furnace direct, have not been successful. If pure alumina and carbon be used for the charge in atomic proportions, the aluminium formed still takes up carbon from the surrounding charcoal, and indeed without an excess of carbon it is difficult to work the furnace. Among the incidental discoveries

resulting from the use of this furnace are the following:—Silicon appears to have a suboxide, as in reducing silica in the furnace, if the operation be stopped before all the material is reduced, three substances are found—reduced silicon, an intermediate greenish compound and silica; the greenish compound being always found intermediate between the silicon and silica. It has not yet been thoroughly examined.

Boron has been found to make a very fine malleable bronze with copper or copper and aluminium.

Another use for this invention, and which is already exciting a large demand in America, is the manufacture of the so-called "mitis" castings, the invention of Mr. Peter Ostberg of Stockholm.

The following is a description of the process taken from an American paper:—

"The wrought-iron scrap is melted in plumbago crucibles in a special reverberatory furnace fired with petroleum. The crucible is covered, and a hole in the cover corresponds with, and is directly under a hole in the top of the furnace. Additions to the charge of the crucible are made through these holes by means of a pipe, thus avoiding the necessity of opening and cooling the furnace. Wrought-iron fuses at a temperature of say 4000 degrees Fahrenheit, and it would be necessary to heat it far beyond the point of fusion before it would be fluid enough to cast into fine moulds, and to make it possible to handle it before it would consolidate. Now it is in this superheating that the iron absorbs gases, and consequently it is impossible to make *solid* castings in this way.

"In order to obviate this difficulty, Mr. Ostberg has made use of the well-known fact that certain alloys of metals possess a fusing temperature much lower than that of the metals composing them, and among these aluminium alloys are especially notable. In making mitis castings a very small quantity, about $\frac{1}{100}$ of 1 per cent. of aluminium, in the form of a 7 or 8 per cent. aluminium alloy of cast-iron, is added to the charge (about 60 pounds) of wrought-iron in the crucible the moment this has been melted. The fusing point is at once lowered some 500 degrees, and the charge, now an alloy of iron and aluminium, becomes extremely fluid and can be cast in the finest moulds, while the great difference between its temperature and its fusing point gives all the time necessary for manipulating it without danger of its solidifying. The extreme fluidity of the charge allows the ready escape of the gases, which, otherwise, would make a porous casting, and the result appears to be a remarkably fine, solid, and tough casting of wrought-iron.

"These mitis castings are said to be from 30 to 50 per cent. stronger than the iron from which they are made.

"The alloys of aluminium and iron and steel have long been known, and reference is made to the addition of such an alloy to steel by Faraday only a few years after the discovery of aluminium; but this application to wrought-iron casting appears to be new, and it is certainly very interesting."

Now as to the ores of alumina. For mitis castings where iron and silicon are not prejudicial, bauxite and various clays can be used with advantage; for bronze making, alumina containing silica in considerable quantity is as available as the pure earth, and is indeed superior. For the manufacture of pure aluminium, pure alumina is requisite. The Cowles Company use corundum, native crystallised alumina, for this purpose; but till 1869 the sole sources of corundum were a few river washings in India and elsewhere. It was found in scattered crystals and cost from 6d. to 1s. a-pound. In 1869, however riding over a spur of the Alleghanies in Northern

Georgia, I found what turned out to be almost an inexhaustible mine of corundum in the Crysolite Serpentine, the first instance on record of corundum having been found *in situ*. It had been washed out of *débris* at Cripps Hill, North Carolina, and a mine in West Chester, County Pennsylvania, both on the slopes of the Crysolite Serpentine, before this. The clue being thus obtained accidentally, about thirty mines were shortly afterwards discovered in the same formation, but of the thousands of tons that have since been dug, by far the larger portion, I believe, has come from the Georgia mine first discovered and worked by myself.

At present the mineral can be bought at the mines at £2 a-ton. This is nearly pure alumina. A hydrated alumina, diasporé, is also found in the same region and localities. We have here sundry samples of corundum, diasporé, and concomitant rocks from the mines formerly owned by me in Georgia and North Carolina. Corundum will probably always be the principal source in America of material whereof to manufacture pure aluminium; fresh mines are being daily brought to light in the Apalachian and Rocky Mountain ranges. But in Great Britain, in all probabilities manufacturers must look to using alumina artificially prepared from cryolite or from Mr. Kynaston's sulphate of alumina. The raw materials from which the latter can be manufactured are inexhaustible. Through the kindness of the Cowles Company, I have here ingots of many varieties of bronzes, specimens of the metal as it comes out of the furnace, of carbon converted to graphite by the intense heat, of slag and of sundry articles manufactured by the Company or others from their alloys.

(Discussion adjourned until next meeting.)

Newcastle Section.

Chairman: J. C. Stevenson, M.P.

Vice-Chairman: B. S. Proctor.

Auditor: N. H. Martin.

Committee:

Alfred Allhusen.
P. P. Bedson.
G. T. France.
C. H. Gillingham.
John Glover.
John Morrison.

F. S. Newall.
John Pattinson.
H. P. Proctor.
W. W. Proctor.
J. F. Stark.
T. W. Stuart.

Local Secretary and Treasurer: J. T. Dunn, 115, Scotswood Road, Newcastle.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held in the College of Science, April 7, 1886.

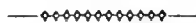
DISCUSSION ON MR. H. R. PROCTER'S PAPER ON TANNIN ESTIMATION, READ AT FEBRUARY MEETING.

MR. H. R. PROCTER made some observations on Simand & Weiss' method of estimating tannin by absorption with hide. This he described as an improvement on several old methods based on the same principle. In Stammer's method the sp. gr. of the solution before and after absorption of the tannin was taken. This process could be made, by great care, to give good results with gallotannic acid; but the extreme care and the time required were objections; and, moreover, for want of data regarding the physical properties of other tannins, it could only be applied satisfactorily to gallotannic acid. Weighing the hide before and after absorption was open to the objection that it was very difficult to extract all the tannin from a solution, and the same objection applied to the

evaporation of the solution and determination of the tannin from loss. Simand & Weiss have proposed to use successive small quantities of hide for the absorption, about 5 grms. being used in quantities of $\frac{1}{2}$ grm. at intervals of about 12 hours. In this way the absorption of the tannin is complete, the hide raspings give up practically no solid matter, and by evaporation of the solution very good results are obtained. The results, too, are direct, requiring no interpretation. If there is much acid present the raspings absorb it; and curiously enough the whole of the colouring matter goes down with the tannin.

Mr. B. S. PROCTOR suggested the application of hide to remove tannin from sherry used to prepare ipecacuanha wine. On keeping ipecacuanha wine it loses strength, a precipitate of tannate of emetin forming. Probably the removal of any tannin from the wine to begin with would prevent this.

Mr. Sisson exhibited an apparatus for the production and storage of hydrogen sulphide for laboratory use, consisting of a small gas-holder with a layer of paraffin oil on the water. Connected with this is a flask provided with a tap-funnel, and a siphon tube besides the gas-delivery tube. Magnesium sulphhydrate is introduced through the tap-funnel and boiled to expel hydrogen sulphide, which finds its way into the gas-holder, and can be used as required. The magnesium hydrate can be run off by the siphon tube, and fresh sulphhydrate introduced without any access of air, and thus a constant supply of pure hydrogen sulphide obtained. The apparatus is practically without smell.



ON THE USE OF MAGNESIUM SULPHYDRATE FOR MAKING PURE SULPHURETTED HYDROGEN.

BY GEORGE SISSON, JUN.

WE have only to look through chemical papers to see the various apparatus and often complicated plans which every chemist, at some time or other of his career, thinks necessary to patent and publish in order to produce H_2S with the least trouble to himself and others.

Magnesium hydrosulphide or sulphhydrate has recently been suggested as a means of producing chemically pure H_2S , and having been spoken favourably of for technical and toxicological investigation by eminent chemists, it seemed worth while to draw the attention of the Society to this new substance, which has only very lately been made on a commercial scale.

The usual method of producing H_2S is by means of ferrous sulphide and dilute HCl , or H_2SO_4 . This gives a mixture of H_2S , with hydrogen and other impurities.

For making pure H_2S it is necessary to use much more complicated and expensive methods. These are boiling sulphide of antimony, with strong HCl , and washing to separate the vapour of acid.

There are various other processes, all more or less troublesome, such as heating a hydrocarbon paraffin, for instance, with sulphur. By galvanic action of a zinc and galena couple in acid, on connecting the wires H_2S is evolved. But generally we must fall back upon sulphide of iron and acid as being the readiest and cheapest.

Two years ago Dr. Divers described a simple process for obtaining chemically pure H_2S . He passed a current of gas from sulphide of iron and acid, through magnesia suspended in water. The H_2S was more or less absorbed, and the magnesia dissolved, forming a solution of magnesium hydrosulphide,

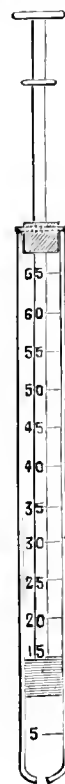
which, on being gently heated, gave off pure H_2S , leaving the magnesia to be used over again.

The samples of hydrosulphide on the table (manufactured by the Washington Chemical Company) are not made by this method, as it was found that magnesia absorbs H_2S rather slowly, and a strong solution could not be obtained; but calcium sulphhydrate is made in the first instance, and from this is made the magnesian solution, by double decomposition with magnesium sulphate.

What answers equally well is a mixture of calcium sulph-hydrate and magnesium chloride (which is the subject of Mr. F. S. Newall's patent). In this way we can bottle and keep for a long time a solution which will give from 30 to 35 volumes of gas. The cost of the gas so produced is about the same as from ferrous sulphide and acid.

a mark is made upon the tube at the junction of the water and mercury; the piston is now lowered until the surface of the water is level with this mark, and the process repeated until the whole tube is graduated.

SAMPLING SYRINGE,
FOR VISCID LIQUIDS.



Birmingham and Midland Section.

Chairman: Alexander M. Chance.

Vice-Chairman: W. A. Tilden.

Committee:

G. S. Albright.

T. Barclay.

Horace T. Brown.

J. F. Chance.

L. Demuth.

W. Hunt.

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C. O'Sullivan.

L. Percival.

E. P. Peyton.

J. H. Player.

C. T. Ryder.

W. A. Wiggin.

A. Wilson.

Hon. Treasurer: Charles Hunt.

Local Secretary:

A. BOSTOCK HILL, 11, Temple Street, Birmingham.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held at Mason College, March 10.

DR. TILDEN IN THE CHAIR.

ON THE SAMPLING OF VISCID LIQUIDS.

BY FRANCIS WATTS, F.C.S.

It frequently happens that it is necessary to analyse and value large quantities of viscid liquids contained in casks, etc., of varying size, the contents of each package as a rule differing in strength and value. It is obvious then that to obtain a sample which shall fairly represent the whole, a quantity proportional to the contents must be taken from each vessel; a viscid character of the liquid renders the necessary measuring somewhat difficult. To accomplish this the writer makes use of a glass syringe graduated into a convenient number of parts of equal volume; the syringe has no nozzle, but only a single round hole in the rounded or slightly pointed extremity, the size of this hole being regulated in accordance with the viscosity of the liquid to be sampled; a convenient form is one graduated in seven divisions, half divisions being indicated by a half line; in sampling a series of casks, for instance, whose sizes vary from forty to seventy gallons, each division of the syringe may be taken to represent ten gallons, or if a series of casks, varying from 100 to 130 gallons, each division might represent twenty gallons. The graduation of the syringe is easily accomplished by inverting it and covering the piston with a layer of mercury to prevent the packing absorbing water; as much water as will conveniently represent either a half or whole division of the tube is now poured upon the mercury, and the piston raised until the upper part of the tube is entirely filled with water,

In using the syringe a small air-space is left between the piston and the ascending column of liquid; this enables the operator to determine with great ease the volume of liquid drawn up: the descent of the piston effectually sweeps out the tube, leaving the syringe ready to be used in drawing the next sample.



THE SOURCES AND VARIETIES OF COMMERCIAL INDIARUBBER.

BY HUBERT PRICE.

INDIARUBBER, or caoutchouc, consists of the dried coagulated juice of various trees and shrubs belonging chiefly to the natural orders of *Euphorbiaceae*, *Moraceae*, *Artocarpaceae*, and *Apocynaceae*. The milky juice in these plants furnishing caoutchouc is contained in the middle layer of the bark in a network of small tubes called laticiferous vessels, but in the *Apocynaceae* these vessels containing the milk are also found in the inner layer of the bark. The caoutchouc is suspended in the milk in small globules about $\frac{1}{12}$ to $\frac{1}{50}$ of an inch in diameter.

The milk is coagulated by acid or saline solutions, but not by alcohol, and it is kept in the liquid state by the addition of ammonia, which is used by the collectors when the caoutchouc has to be carried long distances before coagulation. Caoutchouc

differs from other vegetable products of like origin by being insoluble in water, alcohol, alkalis, and acids, with the exception of concentrated nitric or sulphuric acids.

All caoutchouc contains an oxidised viscid resinous body soluble in alcohol; it occurs in varying quantity, the lowest percentage of this substance giving the greatest commercial value to caoutchouc.

The first mention of indiarubber in any book was nearly 500 years ago by Herrera, who, in the second voyage of Columbus, observed that the natives of Hayti played with balls made of the gum of a tree which, although large, were lighter and bounced better than the wind balls of Castile.

Torguemenda, in 1615, first mentions the name of the tree yielding caoutchouc. He says there is a tree which the Mexican Indians call "Ulequahuil"; it is held in great estimation, and grows in the hot country. It is not a very high tree; the leaves are round and ashy colour. This tree yields a white, milky substance, thick and gummy, and in great abundance.

Even at this early date the Spaniards used to waterproof their cloaks with caoutchouc, and in spite of its being used thus in 1615 by Europeans, it was not until nearly 1800 that it came into use in Europe. The indiarubber trees of South America are of the greatest importance, as they produce the largest supply. The chief of these is the *Hevea Brasiliensis*, commonly called Para, after the town from which it is exported; this tree grows to about 60ft. in height; it is of the Euphorbiaceous species; it branches from the base and has trifoliate leaves.

These trees flourish upon the muddy banks of the Amazon and its tributaries, where the temperature is never below 73° F., rain being seldom absent for more than ten days together, and in the wet season large tracts of forest are inundated. The caoutchouc is collected from August to February, which is called the dry season, but even in the dry season rain falls every few days.

The natives say that the milk flows more freely and in greater quantity in the early morning, so they start out at daybreak.

The collector at the beginning of the season goes round to the trees in his district with a stock of burnt clay cups, laying four to twelve at the root of a tree, according to its size. Footpaths are cleared, and bridges made across the streams; it is about the greatest trouble the collector meets with, as clearing footpaths through the dense undergrowth of a South American forest is a very difficult task.

When all preparations are made, the collector starts out about 3 a.m., taking with him an axe, a wicker basket containing some wrought clay, and a bag to collect odd bits of rubber. Arriving at a tree to be tapped, he takes his axe and strikes in an upward direction as high as he can reach, always striking through the bark and penetrating an inch or more into the tree, thereby damaging its growth, as the wood when exposed soon rots.

Quickly stooping down he takes one of the clay cups, putting a piece of soft clay on one side, sticks it to the bark just below the cut so that the milk will run into it. (The milk when it exudes from the tree is of a dazzling whiteness.) He then makes another cut about five inches from the last and at the same distance from the ground, proceeding as described until he has encircled the tree; he then goes on to the next tree, which he treats in like manner, and so on to other trees.

At about 1 p.m. he returns with a calabash, into which he empties all the cups, as he likes to get his outdoor work completed by 3, because that is the usual time for rain to commence.

On the following day he encircles each tree with cuts about eight inches lower down, and so on day after day until he reaches the ground.

The collectors bring their calabashes of milk to a shed where they have stored some earthen jars and a quantity of the nuts of the *Attalea* and *Euterpe edulis*, both of which are nuts obtained from palm trees; the natives say the smoke of other nuts will not answer the purpose, but I think this can hardly be the case, as the coagulation is really caused by heat driving off the water from the milk.

The milk is poured into a large flat earthen vessel placed on the floor.

The earthen jars, which are 18in. high, 12in. across the base, and 2in. at the neck, have the bottoms broken out; they are placed neck upwards on four stones on the floor, which raises them about three inches. A fire is lighted underneath them, and nuts and wood are alternately dropped into the neck of the jar until it is filled to within four inches of the top. Dense volumes of smoke now begin to issue from the neck of the jar. The collector takes a piece of wood about the shape of the paddle of a canoe, smearing a little clay over it to prevent the rubber sticking to it, dips it into the milk, lets the drops fall off, then passed it about in the smoke which issues from the jar; the milk now assumes a yellowish tinge and solidifies, but still contains much moisture. Thus the collector dips and dries until he has about an inch and a half of rubber on the mould; he then cuts it off, hanging it up to dry, proceeding with another until he has coagulated all his milk in this way. A practised hand will dry five or six pounds an hour; it is very tiring work for the arms.

All the odd bits and scrapings are made into balls about the size of a man's head, and are called negro-heads, both at Para and in the English market. Sometimes amongst the negroheads are found pieces of rubber in the form of dolls' shoes and water bottles.

The Ceara rubber is considered to rank about next to Para. It is the produce of the *Manihot Glaziovii*, a euphorbiaceous tree growing in the province of Rio Janeiro; it attains a height of nearly thirty feet, having three to seven palm-like leaves. It bears a fruit of a very delicious flavour about the size of a plum, which is much prized by the natives. The indiarubber is obtained by slicing the bark off the tree at about four or five feet from the ground; the juice exudes and flows down the stem, some reaching the ground and some drying on the tree, from which it is peeled off in strings; thus the milk of this tree is coagulated by exposure to the weather, no chemical or drying process being used.

Carthagena indiarubber comes from New Granada in sheets about three-quarters of an inch thick, having a rough chewed appearance and an almost tarry consistency. It is believed to be obtained from the *Castilloa elastica*. Guayaquil indiarubber is imported from Ecuador in large flakes of a dark colour, which are sometimes whitish when cut; it is obtained from one of the Castilloa tribe. It contains a great deal of waste.

It is curious to watch how the native mind is enlarged by intercourse with Europeans; as when a fresh source of indiarubber is found it comes first in a wonderfully pure state, but just when confidence has been obtained in the new supply, clay begins to be put into the middle of the large pieces, and as the native mind still more enlarges, all sorts of rubbish are carefully introduced, care always being taken that the impurity does not show until the piece is cut through.

Niearagua indiarubber is obtained from the

Castilloa, a lofty artocarpaceous tree with a trunk three feet or more in diameter. The leaves are eighteen inches long and seven broad. It grows in the rich fertile soils of the moist dense forests which abound in Central America. The milk is obtained by encircling the tree with a spiral cut at an inclination of forty-five feet, at the bottom of which an iron spout about four inches long is driven into the tree to deliver the milk into pails. About twenty gallons of milk are obtained from a tree four feet in diameter, every gallon of milk yielding about two pounds of indiarubber. The milk is coagulated by the addition of the juice of various herbs, about one pint of the juice being added to every gallon of the milk; the coagulum is afterwards rolled and hung up to dry for about a fortnight, when it is ready for exportation. Trees and shrubs yielding indiarubber grow throughout the equatorial regions of Africa. Mozambique is one of the best varieties. It occurs in small balls or spindle-shaped pieces called sausages; these sausages are made by taking small sticks and winding the indiarubber in thin threads round them until they have obtained the thickness and something of the shape of a pork-sausage.

Indiarubber comes from Madagascar in balls and lumps; both this and the Mozambique rubbers are obtained from the vine-like plants *Faheia Madagascariensis*, *Faheia comorensis*, *Faheia gummitera* and *Faheia Senegalensis*. The *Willoughbia edulis*, another climbing plant, is also found; it forms the chief source of indiarubber in the Mauritius. The above-named plants are all climbers, with opposite entire leaves and fleshy fruit.

In Central Africa and the east coast indiarubber is obtained from the *Landolphia Ovariensis*, *Landolphia Florida*, and *Landolphia Hendolii*. In Sierra Leone it is collected from the *Ficus brasili*, and in the Island of Reunion from the *Periploca græca*.

There are also large quantities of indiarubber imported from Asia.

Assam indiarubber is imported chiefly from Calcutta; it is glossy, and of a mottled pink colour, a little like streaky bacon. It is sent over in gummy bags in irregular masses called loaves. This rubber is the produce of the *Ficus elastica*, which is well known to you all as the indiarubber tree used for ornamenting windows; it is used for this purpose because the fumes of gas do not destroy it as they do so many other plants. It seems a curious fact, too, that by giving this plant only a potful of earth it remains alive and flourishing, with but little growth, while in the natural state it becomes a forest tree. In the forests of Assam it is the most prominent tree, the size given of a tree being 100ft. in height, 74 inches in circumference, and the crown covered an area of 610 feet in circumference. It is one of the fig tribe, and has large aerial roots. The milk is collected in the most reckless manner by making cuts about 18 inches long in the trunk and roots, from which the milk flows on to the ground. The milk is coagulated by pouring into boiling water and stirring until sufficiently firm. This is not a very good method, as if too much heat be applied to the milk before coagulation it causes a stickiness which the rubber never loses; this in the English market is called heated rubber, often not fetching more than half the usual price, and when made up into goods causes them to rapidly harden.

The *Ficus elastica* yields about 40lb. of indiarubber at 25 years, about the same amount being obtained every three years until the tree is slowly worn out by reckless tapping. Borneo indiarubber arrives in the market in shapeless masses of a whitish or pinky colour, which when cut often have a very disagreeable odour. This rubber is obtained from the

Urceola elastica *Willoughbia firma*, and *Urceola esculenta*. The former two are climbing plants, with trunks about the size of a man's body; they have a soft thick bark. The latter is a tree which at the age of five years has a stem 18 inches in circumference, and its crown covered an area of 200 square feet, which shows the rapid growth of some of the tropical trees. The milk from the climbing plants is extracted by cutting them into pieces about two feet long, which are drained into buckets and sometimes even boiled to extract the milk. The milk is coagulated by mixing with salt water, which causes the rubber to arrive here in a very damp condition, and it loses from 20 to 50 per cent. when cleaned and dyed by the manufacturer.

There are a large number of other plants which yield indiarubber, but I think I have mentioned enough to dispel the general idea that indiarubber comes from one species of tree.

Indiarubber is composed of carbon and hydrogen—87.27 per cent. of carbon, and 12.73 per cent. of hydrogen. When exposed to a temperature of 0° Centigrade it gradually loses its softness and elasticity, becoming rigid and inelastic, but may be restored to its normal condition by heating to 35°, or by stretching to twice its normal length, which takes considerable force in this rigid condition. The effects of heat are more complex than those of cold. Let us say that 15° Centigrade is the ordinary temperature, and if a strip of indiarubber be stretched by a weight and then the temperature raised to 40° C., the strip will contract, but the contracting is accompanied with a more than corresponding increase in thickness. If the heat be raised to 100° or 120° it becomes soft and loses its elasticity, but regains it when cooled. At a temperature of 150° it becomes viscous, and at 200° fairly melts, forming a thick liquid, which, when cooled, does not resume its former state. At still higher temperatures it is split into volatile hydrocarbons, leaving only a carbonaceous residue. The mixed products of dry distillation are excellent though rather expensive solvents for indiarubber. Indiarubber when pure is odourless and nearly white. The milk has a specific gravity of 1.012, but when coagulated it is .925. When freshly cut it easily unites again when pressed together.

Benzol, its homologues, carbon bisulphide, petroleum, volatile oils, chloroform, and melted naphthalene are solvents for indiarubber to a more or less degree.

It is said that if indiarubber be submitted to the action of ammonia for several months, it exerts the curious influence of bringing it back to an emulsion.

If a strip of indiarubber be stretched to about seven times its original length for two or three weeks, it loses its elasticity, and only regains it again on being subjected to heat. Possibly it takes up heat which it has lost, as when stretched it gives out a very considerable amount of heat. When in the inelastic state just described, the specific gravity rises from .925 to .9487. I will next say just a few words about the manufacture. The indiarubber, when it arrives in the crude state, has to be thoroughly cleaned from all its impurities and then dried. To effect this it is first put in large iron tanks of hot water for some hours to make it soft. When soft enough it is passed through rolls with water constantly running on them, so that when the rubber is pressed into thin pieces the dirt is washed away. This first set of rolls are not placed very close together. After it has been worked in them it is put through a close set, and after that through a set close enough to make a sheet such as I have here. These sheets are hung up in rooms heated with steam pipes, for about three weeks, and then a week in an open shed, when they are tied

up in bundles ready for use. The next process is to mix the indiarubber with sulphur and other chemicals, which is done by grinding between two rollers travelling at different speeds and heated with steam. This grinding process takes several hours. When the rubber and chemicals have been thoroughly mixed, they are passed through steel or chilled iron rollers, which have to be very smooth and true to give an equal thickness and smooth surface. These rolls are also for most goods heated.

The rubber may be fixed on cloth by passing through the above-mentioned rolls with a cloth. As the sheets come out from these rolls they are wound on to a mandril, with calico between each layer to prevent it all sticking together. These thin sheets are then in various ways made into different articles as required. The rubber at this stage is in a soft state and can be pulled in pieces and stuck together or pressed into any shape by means of an iron mould. When made into the shape required by moulding or other ways, it has to be vulcanised. This is done by heating the indiarubber with sulphur intimately mixed with it. The exact action is not known, but it seems to most nearly resemble the change of iron into steel. Some have said that it takes an allotropic form. It is said that two per cent. is about the right amount of sulphur to use, but manufacturers use from 5 to 12 per cent. Only a small proportion of this is really chemically combined with the rubber; the rest remaining intimately mixed with it, and causes the process of vulcanisation to slowly go on, especially if exposed to heat; this causes the indiarubber to become brittle.

The effect of the sulphur seems to cause a setting of the sticky and resinous portion of the indiarubber, giving it greater elasticity, and destroying its stickiness and power to be cut in pieces and stuck together again. If a large quantity of sulphur be added to indiarubber, when vulcanised it becomes quite hard, and under the name of vulcanite or ebonite, is used to make combs, paper knives, and many surgical instruments. The black colour of vulcanite is also curious, as before vulcanisation it appears grey in colour, but when vulcanised and polished it is jet black. Vulcanite has not much elasticity, breaking when bent sharply. It resists solvents more pertinaciously than ordinary rubber. A great variety of stiffness may be obtained in indiarubber by adding different amounts of sulphur, from a billiard cushion to a vulcanite ruler.

The process of vulcanisation was discovered by Goodyear, an American, who after a great number of experiments hit on this by accident.

A Mr. Parks invented a method of cold vulcanisation. He dips the article to be vulcanised in 100 parts of sulphuret of carbon, and $2\frac{1}{2}$ parts of protochloride of sulphur, for a few minutes, then he immersed the indiarubber in cold water. This method will only vulcanise a thin substance of rubber.

The usual way vulcanisation is carried out by manufacturers is by placing the goods to be vulcanised in a long iron tray, filled with French chalk, which is pressed tightly over the goods. The tray is then run along a tramway into an iron cylinder, made of boiler plate, ends are then securely screwed on, and the steam is turned into it. Different manufacturers use different pressures, varying from 60lb. to the square inch to 15lb. The time the trays are left in the boilers, of course, depends on the heat and the amount of sulphur in the goods. It runs from 7 hours to 5 minutes, and for some special articles it takes days.

Various attempts have been made to manufacture a substitute for the actual caoutchouc, which will cut out the natural product, but at present they have not been attended with very satisfactory results. Many

articles are sold for rubber substitutes, and a good deal is used to mix with the genuine article, as no very satisfactory result has been obtained when they are used alone. Of course, when mixed with rubber they deteriorate the quality, but they keep the goods light, without adding to the cost, and the adulteration is almost impossible to detect by analysis. The ordinary substitutes, such as I have here, are made of castor oil and chloride of sulphur.

Dr. Fleming has a patent substitute, which he uses for insulating purposes, without any native india-rubber, but it is not a success. It is made by taking some substance, as wood cotton or straw, and dividing it very finely, then saturating with melted bitumen or asphalt, incorporated with silicate of magnesia, lime, iron or alumina; then mix in amber resin or kauri resin, heat to 250 per cent., and mould into shape required under pressure.

Harrison's substitute consists of Agar-Agarseaweed, dissolved in acetic acid, then add cowrie gum, pistacia gum, castor oil, and Stockholm tar; stir and boil till consistency of treacle, then cool, roll and dry.

Zuighi makes a substitute by dissolving half-a-cwt. of cowrie gum with an equal quantity of manilla gum, in 5 gallons solvent naphtha, adds 2lb. of camphor and 5lb. of aluminous matter, heats to 250° F., then adds 20 per cent. of native rubber, and treats in a masticator with 10 per cent. of castor oil.

Hoffman's substitute is made by boiling skins of bares and rabbits in water, with 5 per cent. of glycerine, evaporate to dryness, add an equal quantity of glycerine, and 1 part of concentrated solution of bichromate of potash. It is then heated and poured into moulds, and hardened under pressure. There are also many other mixtures used, but none come any way near the native article.

Most substitutes contain a certain amount of acid, which causes a rotting of the cloth they are spread on.

The electric macintoshes lately so much in vogue, contain a large quantity of substitutes, and the process by which they are made has the curious effect of sending some of the employes out of their minds.

Many people seem to think that red rubber is better than grey, but the colour is no check on the quality, as it is only obtained by the addition of pentasulphide of antimony, vermilion oxide of iron, or other colouring matter.

I will not now add more to this paper.



ON THE USE OF TURMERIC AS AN INDICATOR FOR CITRIC ACID.

BY FRANCIS WATTS, F.C.S.

WHEN litmus is employed as an indicator in the alkalimetric determination of citric acid, some difficulty is experienced on account of the want of sharpness in the indications; citrates of potash and soda being slightly alkaline to litmus, the results obtained are frequently too low. To remove this difficulty, Warrington, in his Notes on the Chemistry of Tartaric and Citric Acids, * recommends the preparation of a special litmus paper, but even with this precaution the difficulty is not entirely overcome. I have found the following method give good results. A tincture of turmeric is prepared with strong spirit, drops of this are placed on a white tile, or better, in the depression of an ordinary colour slab. The liquid spreads out in bright yellow films; drops of the solution being tested are from time to time placed on these yellow films. As the addition of the alkali proceeds, the slightest excess of alkali causes the

development of the well-known red-brown colour. This indicator can be used in the cold, and also works well in the analysis of concentrated lemon or lime-juice, the red-brown colour being readily seen even in the presence of the dark liquids which have to be dealt with in these cases, in which the delicate pink of phenolphthalein (which has been recommended as an indicator of citric acid) is scarcely visible.

In order to test the delicacy of tincture of litmus as an indicator, the following experiment was made: About three grains of citric acid were nearly neutralised with caustic soda and carbonate of barium added in excess; the mixture was boiled and filtered. The filtered and boiled solutions did not cause the development of a pink colour with phenolphthalein, neither did it change the colour of the yellow turmeric film; litmus paper, however, was turned decidedly blue by it.

A faint pink colour was developed in phenolphthalein by the addition of less than .0015grm. NaOH, a strong pink colour being caused by the addition of .0025grm. to the above solution.

With turmeric a slight change was noticed when .0028grm. NaOH had been added, and a decided change with .0042; this latter quantity produced a sufficiently deep red to have been noticeable with dark solutions. When this last solution was diluted to five times its volume (being originally 20cc.) the red-brown colour was still developed on adding a drop to a turmeric film. It will be seen that much greater certainty arises from the use of this indicator in the place of litmus.

In using this indicator much time is saved by employing litmus paper to determine the near approach to neutralisation, proceeding with the addition of the alkaline solution until the litmus paper is turned slightly blue, and determining the exact point of neutralisation by means of the turmeric. In the case of unconcentrated lemon and lime-juices the change of colour of the juice when nearly neutralised renders the employment of litmus paper unnecessary.

Note.—I am indebted to the kindness of the Montserrat Co., for permission to publish these notes; the experiments on which they are founded being conducted in their West Indian Laboratory.

ON THE FERMENTATION OF CITRIC ACID.

BY FRANCIS WATTS, F.C.S.,

*Chemist to the Montserrat Company (Limited),
Montserrat, W.I.*

WARRINGTON* has made an attempt to ascertain the amount and nature of the volatile acids in concentrated Sicilian lemon-juice with a view to determine the acids, other than citric, to be found in lemon-juice. Now when perfectly fresh lime-juice is distilled, the distillate is neutral, and consists only of water, with a little essential oil derived from the peel. It is thus clear that volatile acids are not normal constituents of the juice, and some explanation of their presence seems necessary.

When lime-juice is allowed to stand for some days in an open vessel, a film of mould gradually forms upon the surface; this, when examined under the microscope, is found to consist of numberless cells of *saccharomyces mycoderma*.† If juice which has

been in this condition for several days be now distilled, the distillate is found to be acid. 1000cc. of such juice were submitted to distillation, 200cc. being first collected. This acid distillate was now rendered alkaline, and again distilled to separate any alcohols that might be present. The alcoholic distillate was mixed with a little sulphuric acid and bichromate of potash, gently warmed, and finally distilled, yielding a distillate having an acid reaction. The very small quantity of acid thus obtained only permitted a superficial qualitative examination. On the addition of nitrate of silver only a very slight reduction took place on warming. Ferric chloride in neutral solution gave a very decided red colouration. An attempt was made to identify propionic acid in the mixture by means of the basic lead salt, but owing to the small quantity of material only equivocal results were obtained. From these reactions we may infer the presence of acetic acid, a minute trace of formic acid, and possibly some propionic, and indirectly the existence of ethylic alcohol, with possibly some propylic and minute quantities of methylic alcohols, in the original juice after fermentation.

The residue from which the alcohols had been distilled was mixed with a second distillate of 200cc. from the original 1000cc. of juice, very nearly the whole of the volatile acids being thus collected. This liquid was then neutralised with caustic soda, and concentrated; on the addition of ferric chloride the red colouration indicative of acetic acid was obtained. The addition of other reagents gave no decisive results, though it seemed probable that some propionic acid was present.

In order to determine the presence of ethylic alcohol in the fermented juice, 500cc. were submitted to distillation, the product carefully rectified, and C_2H_5OH sought by means of the iodoform test; only a very slight precipitate of iodoform resulted.

From the above examinations it was evident that very slight quantities of volatile acids or alcohols resulted from the changes experienced by the juice in keeping.

The residue resulting from the distillation of the 100cc. of juice was now rendered alkaline with caustic potash and again distilled, and a liquid strongly alkaline with ammonia passed over. In order to detect any alcohols resulting from the decomposition of citric ethers, the alkaline liquid was neutralised with hydrochloric acid, the alcohols distilled off, warmed with a small quantity of chromic acid mixture, and finally distilled. A feebly acid distillate was obtained, which gave no red colour with ferric chloride in neutral solution. Oxide of lead in excess was added to the distillate; the resulting basic lead salt of the volatile organic acid was soluble in water, so that probably propionic acid was present (basic butyrate of lead is insoluble). From this it may be inferred that some citric ether is present, that it is not ethyl citrate, but is probably propyl citrate in very small quantity.

Having thus found that volatile products (other than CO_2) are not formed in any quantity by the development of this *saccharomyces* in the liquid, experiments were now undertaken to prove that citric acid is not split up into other non-volatile acids.

Experiment I.—For this purpose a quantity of freshly-pressed lime-juice was set aside for the mould to develop, and the free acid and citric acid determined at intervals.

Experiment II. was conducted on juice from un-soured fruit, fermentation being promoted by the addition of juice containing mould. The results of the analysis are given in the subjoined tables and

* Journal Chem. Soc. October, 1875.

† Messrs. W. Southall and W. B. Grove very kindly undertook the further examination of this fungus for me. My own observations induced me to think that at least two distinct varieties existed. Grove, however, seems inclined to consider the different forms observed as transient phases in the life of this very variable fungus. The point for the present remains undecided.

diagrams. The free acid is stated in terms of citric acid. Before the sample was withdrawn for analysis the juice was thoroughly stirred up. This may have made the action of the fungus slightly irregular.

The determination of the citric acid was conducted in the manner recommended by Warrington (*loc. cit.*):—

EXPERIMENT I.

Day.	* Free Acid per cent.	Citric Acid per cent.	Citric Acid per 100 of Acidity.
1	8.72	8.40	96.32
4	8.62	8.33	96.63
7	8.36	8.20	99.16
18	8.24	7.90	95.82
23	8.00	7.70	96.25
28	7.94	7.40	93.20
32	7.48	7.10	94.92
36	7.34	7.10	96.73
43	6.81	6.32	93.32
49	6.72	6.42	95.55
53	6.59	6.18	93.07
58	6.16	6.06	91.88
64	6.00†	5.80	96.66
68	5.86	5.70	97.26
73	5.66	5.46	96.46
81	5.26	5.08	94.67
91	4.96	4.72	95.16
95	4.80	4.68	93.92
103	4.50	4.40	97.77
111	4.26	4.20	98.69
129	4.12	3.76	92.18
203	2.96	2.76	97.46

* The term "per cent." here really means grms. per 100cc.

† From this date turmeric used as indicator, and all through Experiment II.

EXPERIMENT II.

Day.	Free Acid per cent.	Citric Acid per cent.	Citric Acid per 100 of Acidity.
1	8.56	8.32	97.31
7	8.44	8.18	96.91
12	8.06	7.81	96.54
19	7.60	—	—
21	7.50	7.06	91.13
31	6.82	6.56	96.18
35	6.42	—	—
40	6.00	5.66	91.33
50	5.26	4.91	93.93
95	4.11	3.80	91.99
233	.54	—	—

Now, if other acids were formed at the expense of the citric acid, it is at once evident that the proportion of citric acid to total free acid would become smaller and smaller, and the curves in the diagram diverge as the fermentation proceeded; this, however, is not the case.

The loss of citric acid is not, therefore, attended by the formation of volatile substances (CO_2 excepted), nor of non-volatile acid. That non-volatile neutral bodies are formed to any appreciable extent does not seem very probable.

Stoddart states ("Pharmacographia," art. "Lemon-juice"), that when lemons had been kept six months the citric acid was largely converted into grape-sugar. Only slight reduction of Fehling's solution took place when mouldy lime-juice was boiled with it, corresponding to about .1 per cent. $\text{C}_6\text{H}_{12}\text{O}_6$.

In order to examine the effect of the growth of the fungus in citric solutions free from saccharine and gummy matter, a solution of citric acid was mixed with the bodies necessary to plant life (in reality, Pasteur's solution, with citric acid substituted for sugar and tartaric acid). This solution was then seeded with a little "cultivated" *saccharomyces mycoderma*, free from bacteria and other bodies which are largely associated with it in natural juice. As the development of the mould proceeded, carbonic acid was given off, though no bubbles of gas escaped from the liquid, the gas being gradually evolved from the film of mould. When the fermentation had so far proceeded that 15 or 16 per cent. of the citric acid had disappeared, a portion of the solution was distilled; the distillate was perfectly neutral, and consisted of water only—no alcohols could be detected. The citric acid was now removed from a portion of the solution, as calcium salt, and an attempt made to examine the residue for neutral bodies; but the liquid soon swarmed with bacteria, and became putrid, so that the examination had to be abandoned. The volatile bodies found in the examination of natural juice after fermentation must therefore be due either to the presence of saccharine matter or to the action of other ferments—most probably to the combined effects of both.

It has been shown that no other acid than carbonic is formed during this process, and also that no volatile bodies are produced; it now remains to be proved that no non-volatile compounds are formed.

A solution containing 2.2080 grms. of dried citric acid ($\text{H}_3\text{C}_6\text{H}_5\text{O}_7$) and .1278 grm. of mixed mineral matter necessary for the support of vegetation in each 100cc. was prepared. Of this solution 200cc. were set aside to ferment, and sown with a small quantity of *saccharomyces*; at the end of fifteen days the film of mould contained, in addition to the *saccharomyces*, a patch of *penicillium*, and also of *aspergillus*; the liquid was filtered and made up to 200cc.; on analysis this was found to contain 1.408 grms. dry citric acid per 100cc. Of this liquid 150cc. were evaporated to dryness in the water-bath, and the residue maintained at a temperature of 100°C ., until the weight became constant; it yielded a residue weighing 2.2527 grms. Now, assuming for the moment that the mineral matters in the solution had remained unaltered, the theoretical weight of the residue for 150cc. would be as follows:—

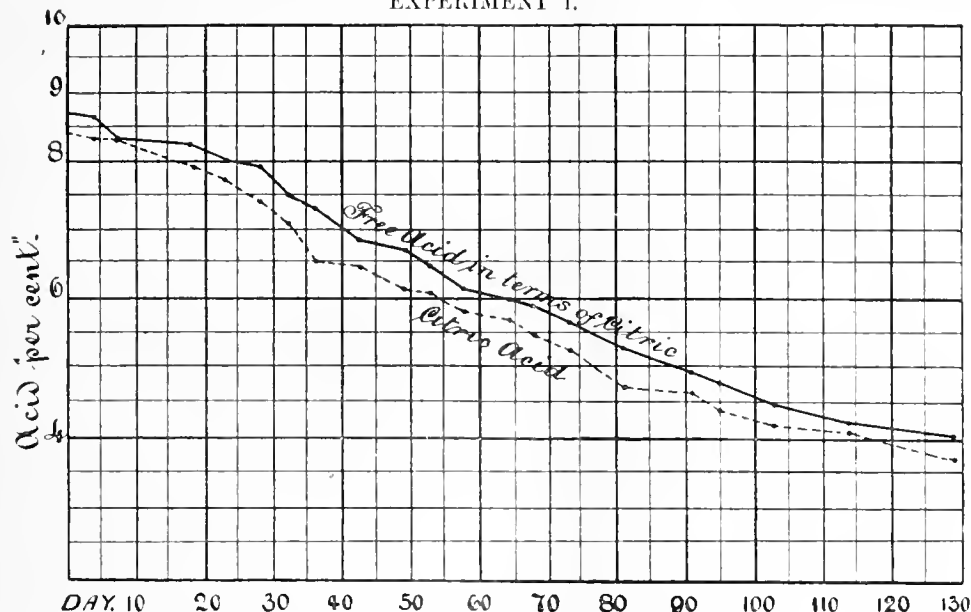
Citric acid	2.112 grms.
Mineral matter.....	.1917 "
	<hr/> 2.3037 "

instead of which we have the weight 2.2527, which is deficient by .051 grm., a portion of which deficiency is probably due to the removal of mineral matter in the mould. This result proves most conclusively that no non-volatile body is produced during the fermentation. It will be noticed that 36.36 per cent. of the citric acid, originally present, was lost by fermentation in fifteen days.

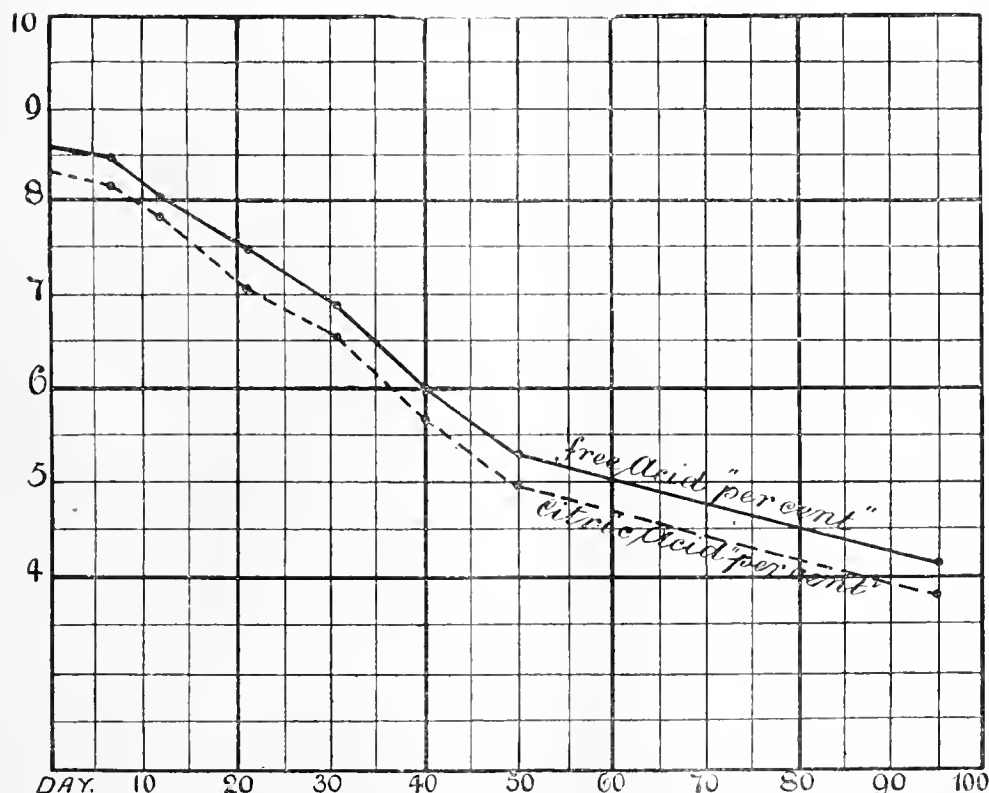
Determination of the Rate of Loss in Equal Volumes of Citric Acid Solutions, with different areas exposed to the Action of Saccharomyces Mycoderma.—A solution containing suitable mineral matters with 5.48 grms. of citric acid $\text{H}_3\text{C}_6\text{H}_5\text{O}_7 \cdot \text{H}_2\text{O}$ per 100cc. was prepared. Of this liquid three separate lots of 250cc.

little saccharomyces mycoderma. On the 18th day the solutions were analysed—the volume lost by evaporation being made up by distilled water. The loss in the case of *a* was 8.87 per cent. of the original acid; *b*, 17.89; *c*, 33.57. From this it appears that the loss of acid is not directly in proportion to the

EXPERIMENT I.



EXPERIMENT II.



each were set up in vessels having the following relative areas exposed to the air and the action of the mould—*a* area exposed=1, *b* area exposed=4.38, *c* area exposed=8.26; each solution was sown with a

area exposed to the air and mould; for, taking the loss in the case of *a* as unity, we have—

Areas of exposure... *a* 1, *b* 4.38, *c* 8.26
Loss of acid = 1, = 2 = 3.4.

This variation is probably due to movements in the fluids, successive particles of the solution coming in contact with the mould.

From these experiments, then, it is evident that, under the influence of *saccharomyces mycoderma*, citric acid is split up directly into carbonic acid and water, oxygen being absorbed. It was found that the growth of the mould ceased shortly after air was excluded. This is simply in accord with the general law, that ferments forming a mycelium and floating on the surface of a suitable fluid, oxidise and split up the substances on which they act into simple carbonic acid and water.

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Notices of papers and communications for the meetings to be sent to the Local Secretary.

ERRATUM.—On p. 118 (March issue), 2nd column, line 25, for "runs" read "errors."

The Sixth Meeting of the Session was held in the Rooms, 207, Bath Street, on Tuesday, 6th April, 1886.

J. M. CUTHBERTSON, ESQ., IN THE CHAIR.

ON ALGINIC ACID AND ITS COMPOUNDS.

BY E. C. C. STANFORD, F.R.S.

MANY of the compounds which I propose to bring before the Section this evening were exhibited in London last year at the Inventions Exhibition, and a lengthened notice of these by Watson Smith was published in our Journal last September. These products have never been described, and had only then been prepared and shown for the first time. In consequence, however, of that notice, I have been overwhelmed with inquiries, many of which I have been unable to answer, from all parts of Europe and beyond it.

These inquiries have assured me of the great publicity which the Journal of this Society gives to any information appearing in its columns, and have also led me to believe that considerable interest is taken by many of its readers in these new substances.

I propose, therefore, briefly to describe the most important, and to indicate their composition so far as my investigations have hitherto extended. Considering the general character of these compounds, I think it will be admitted that the analytical results are extremely satisfactory.

The starting-point in the preparation of all these compounds is insoluble algin, or alginic acid. I have

fully entered into the manufacture of this substance in a former paper, and need not further allude to it here.

Alginic Acid is a nitrogenous organic acid. As first precipitated it forms a light-brown gelatinous precipitate. When reprecipitated it becomes nearly colourless, and can be obtained perfectly white. The precipitate, when well washed, is extremely retentive of water, taking up over 98 per cent. In this form it is somewhat difficult to deal with, as it cannot be pressed, although it is easily filtered off; and, as might be expected with such a body, it is impossible to completely wash out the salts and obtain it free from ash. It dries up to a horny substance resembling albumen, and has then a specific gravity of 1.534; that of the ivory nut is 1.376. It can be turned and polished in the same manner. It is easily obtained in thin transparent sheets, which possess considerable tenacity. In this form it is an efficient substitute for bladder in tying over pots and bottles; it softens in water and becomes pliable in the same way, and it dialyses equally well. It can be readily coloured as shown in the red and blue samples on the table. In this form it resembles coloured sheets of gelatine, but unlike these is unaffected by hot water. It is a moderately strong acid, evolving carbonic acid in the cold from the alkaline carbonates, and from magnesium carbonate. I must leave the consideration of several interesting decompositions of this substance for a future paper, but subject to any further light which any of these may ultimately throw on its constitution, I append what I believe to be the formula. This was derived from two combustions of a carefully-purified specimen; and the figures obtained accord with the formula $C_{38}H_{40}NO_{11}$.

	1.	2.	Mean.	Calculated.
Carbon	65.151	64.80	64.977	64.985
Hydrogen	5.667	5.80	5.734	5.700
Oxygen	24.762	25.16	24.961	25.020
Nitrogen	2.117	1.94	2.028	1.995
Ash	2.300	2.30	2.300	2.300
	100.000	100.00	100.000	100.000

Subsequent analyses of the alginates, however, have led me to the conclusion that this formula must be doubled, and that the true composition of the acid is $C_{76}H_{80}N_2O_{22}$; or it may be expressed as a diamide—



There appears to be a remarkable relationship between this body and albumen. If we accept Gerhardt's formula for albumen, $C_{72}H_{112}N_{18}SO_{22}$, and deduct from it the sulphamide, N_2H_4S , which Mulder assumes it to contain, and then deduct also 14 molecules of amidogen, NH_2 , it leaves the formula $C_{72}H_{80}N_2O_{22}$, which only differs from alginic acid by 4 atoms of carbon. Whether the process can be reversed, and albumen built up from algin remains to be seen; it would be a very important synthesis, and many more complicated and more difficult have been accomplished. It bears no relation to the ordinary vegetable pectin compounds, even if it were non-nitrogenous, the formula of pectin being $C_{32}H_{48}O_{32}$, and that of pectic acid $C_{16}H_{22}O_{15}$. Albumen is a very weak acid, acid or soluble sodium albumenate, $C_{72}H_{111}NaSO_{22} + H_2O$, contains only

1.66 per cent. Na. It is singular that the insoluble albumenate contains more soda. The general formula of the alginates I take to be $C_{7.6}H_{7.7}M_3N_2O_{2.2}$, although there are some important differences from this type.

Soluble Alginates.—The soluble alginates are those of sodium, potassium, ammonium, lithium, and magnesium.

Sodium Alginate.—This salt is the ordinary soluble algin; analogous to soluble albumen. It is best prepared by acting on moist alginic acid by sodium carbonate. The properties of this soluble alginate have been already described; the most remarkable reactions are, that it is at once coagulated by nearly all acids, or by alcohol, but not by acetic acid, nor by heat; that it does not gelatinise; that it precipitates all the alkaline earths except magnesium, and all the metals except mercury as mercuric chloride. It is usually obtained in thin sheets, which are soluble in cold water, forming a very gelatinous solution. It takes some time to dissolve, and is therefore washed from any vessel containing it with difficulty.

This solution may be employed as a general dressing or finishing material of an elastic flexible character, which can be converted into a lustrous hard glaze by passing it through a weak acid or lime salt. This process, which would destroy the ordinary starch and gum dressings, renders it quite insoluble in water, the fabric becoming waterproof.

Sodium alginate gave by analysis 8.04 per cent. Na. The following formula requires 7.75 Na = 23:— $C_{7.6}H_{7.7}Na_3N_2O_{2.2}$.

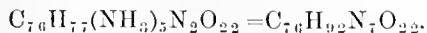
This alginate has an acid reaction, and is an acid alginate, and represents the least proportion of sodium necessary to render it soluble. The same remark applies to the other soluble alkaline alginates, all of which have an acid reaction, and the base in each salt is not saturated. The probability is, if quite neutral, there would be at least six atoms of the metal present. I have little doubt of this, but it is not yet conclusively proved; and in all the following analyses the figures are corrected for the extraneous matter impossible to eliminate.

The alginates of the other alkali metals resemble that of sodium in general properties, the different bases presenting advantages in some applications.

Potassium Alginate gave by analysis 12.51 per cent. K.

The following formula requires 12.49 K = 39.1:— $C_{7.6}H_{7.7}K_3N_2O_{2.2}$. It is prepared by acting on moist alginic acid by potassium carbonate. Reaction, acid.

Ammonium Alginate gave by analysis 5.65 per cent. NH_3 . The following formula requires 5.84 NH_3 = 17:—



It is prepared by dissolving moist alginic acid in ammonia. It combines with a number of metallic alginates and other bodies, which will be further alluded to presently. Reaction, acid.

Lithium Alginate gave by analysis 2.30 per cent. lithium. The following formula requires 2.49 per cent. Li = 7:— $C_{7.6}H_{7.7}Li_3N_2O_{2.2}$. It is prepared by acting on moist alginic acid by lithium carbonate. Reaction, acid.

Magnesium Alginate gave by analysis 4.18 per cent. Mg. The following formula requires 4.20 per cent. Mg = 24. $Mg_2(C_{7.6}H_{7.7}N_2O_{2.2})_2$. Reaction acid. This remarkable body is prepared by acting on moist alginic acid in the cold with magnesium carbonate or oxide. In the former case carbonic acid is abundantly given off, and the two insoluble substances combine to form a dense colourless solution, which dries up to a film, closely resembling that of sodium

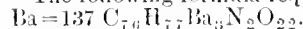
alginate, but it is more brittle, and forms a stiffer dressing for fabrics.

Insoluble Alginates.—Some of the metallic alginates are very soluble in ammonia. I will refer, in the first instance, to those which are insoluble in that alkali. In most of these compounds the metal can be dissolved out by hydrochloric or other strong mineral acid, leaving the alginic acid unchanged. The metals may replace a greater or less number of atoms of hydrogen than those given in the formula, so that the exact constitution of these salts is not yet absolutely determined, but all are calculated on the same basis; and the results are fairly consistent.

Barium Alginate is a dense white gelatinous precipitate prepared by acting on calcium chloride with sodium alginate, both in solution.

Analysis gave barium 23.02 per cent.

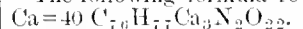
The following formula requires Ba 23.17 per cent.



Calcium Alginate is a white gelatinous precipitate prepared by acting on calcium chloride with sodium alginate, both in solution.

Analysis gave calcium 7.84 per cent.

The following formula requires Ca 7.66 per cent.

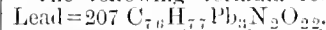


This substance hardens into hard solid white blocks, which take a good polish. In this form calcium alginate has a specific gravity of 1.609; that of ivory is 1.82. It can also be prepared in transparent flexible sheets.

Lead Alginate is a transparent colourless gelatinous precipitate, obtained by precipitating lead acetate with sodium alginate.

Analysis gave, by reduction, lead 30.8 per cent.

The following formula requires 31.29 per cent.



Bismuth Alginate is a dense white gelatinous precipitate obtained by precipitation from bismuth nitrate by sodium alginate solution.

This substance has not yet been examined.

Mercurous Alginate.—Sodium alginate has no action on mercuric chloride, which distinguishes it from albumen. Mercurous alginate forms a dense white gelatinous precipitate, and is obtained by the action of sodium alginate on mercurous nitrate, both in solution.

It is blackened by ammonia.

This substance has not yet been examined.

Insoluble Alginates, which are soluble in ammonia. All these form double salts, or ammonia alginates, some of which present beautiful films. The bases are masked, and do not present the ordinary characteristic reactions.

Strontium Alginate is a dense white gelatinous precipitate formed by precipitating a solution of strontium chloride with sodium alginate.

Analysis gave strontium 15.51 per cent.

The following formula requires Str 16.10 per cent.

$Str = 87.5 \quad C_{7.6}H_{7.7}Str_3N_2O_{2.2}$. The precipitation is not so well defined as in the other alkaline earths. This substance is remarkable for its solubility in ammonia. Strontium ammonio-alginate forms a white tenacious film insoluble in water.

Aluminium Alginate forms a white gelatinous precipitate, obtained by precipitating aluminium sulphate in solution by sodium alginate.

Analysis gave aluminium 6.40 per cent.

The following formula requires Al 6.59 per cent. $Al = 27.5 \quad Al_2(C_{7.6}H_{7.7}N_2O_{2.2})_2$. The proportion here is abnormal, as in many aluminium compounds. This substance is soluble in caustic soda, and the solution evaporated forms an excellent film resembling that of sodium alginate, but stiffer; it is very soluble in water, and would form a cheap and efficient glaze for paper or cloth. It is quite neutral.

Aluminium alginate is very soluble in ammonia, forming aluminium ammonio-alginate, which becomes insoluble when dry. It will form a cheap water-proof varnish. Alumina is completely removed from solution as alginate; not a trace can be afterwards found in the liquid. The alumina can be completely separated from an acid solution of redonda phosphate as alginate. The gelatinous character of the precipitate makes it a good mordant or dung substitute; adhering to the cloth and not easily rubbed off.

Copper Alginate is a green gelatinous precipitate, obtained by precipitating cupric sulphate by sodium alginate in solution.

Analysis gave copper 12.20 per cent.

The following formula requires 12.25 per cent. $\text{Cu} = 63.5 \text{ C}_{7.6} \text{H}_{7.7} \text{Cu}_3 \text{N}_2 \text{O}_{2.2}$. A combustion was made of this salt, but by an accident only the hydrogen was estimated correctly. The formula requires H 4.937. The analysis gave H 4.92. This compound is very soluble in ammonia, forming a beautiful deep blue solution of cuprammonium alginate, which dries to a bright green film, insoluble in water.

Analysis of this salt gave copper 16.98 per cent.

Ammonia (NH_3) 6.58 per cent.

The following formula would require $\text{Cu} 17.51 \text{ NH}_3 6.64$ per cent. $\text{C}_{7.6} \text{H}_{7.7} \text{Cu}_3 \text{N}_2 \text{O}_{2.2} + \text{Cu}_2(\text{NH}_3)_7$.

One or more atoms of NH_3 have probably been lost on evaporation; but this compound requires further investigation, and I only give a suggested formula. This substance may be useful as a varnish, especially for waterproofing fabrics which are liable to decomposition or to attacks of insects. Cuprammonium solution cannot be obtained stronger than two to 2½ per cent. of copper, and cannot be preserved if it contains more than 1.5 per cent. of copper. This compound contains eight times as much of the metal, and it is soluble in water in almost any proportion before drying.

Nickel Alginate is a light green gelatinous precipitate, prepared by precipitating nickel chloride by sodium alginate in solution.

Analysis gave nickel 11.49 per cent.

The following formula requires 11.42 per cent. $\text{Ni} = 58.6 \text{ C}_{7.6} \text{H}_{7.7} \text{Ni}_3 \text{N}_2 \text{O}_{2.2}$.

It is soluble in ammonia, forming a beautiful blue solution which dries to a brilliant green film, insoluble in water.

Cobalt Alginate is a light red gelatinous precipitate prepared by precipitation from cobalt nitrate solution with sodium alginate.

Analysis gave cobalt 11.35 per cent.

The following formula requires Co 11.42. $\text{Co} = 58.6 \text{ C}_{7.6} \text{H}_{7.7} \text{Co}_3 \text{N}_2 \text{O}_{2.2}$.

It is soluble in ammonia, dissolving to a bright red solution, which dries to a dark red film insoluble in water.

Ferric Alginate.—Ferrous sulphate yields no precipitate with sodium alginate, but if the slightest trace of a ferric salt be present, a reddish-brown gelatinous precipitate of ferric alginate is obtained.

Analysis gave iron 10.92 per cent.

The following formula requires 10.97 per cent. $\text{Fe} = 56 \text{ C}_{7.6} \text{H}_{7.7} \text{Fe}_3 \text{N}_2 \text{O}_{2.2}$.

Iron is so completely precipitated by sodium alginate that not a trace can be found in the filtrate by the most sensitive colour test.

Ferric alginate is soluble in ammonia, forming a deep red solution, which on evaporation affords a dark red film insoluble in water. This substance is likely to become useful in surgery as a styptic for wounds, and in medicine as another means of administering iron internally.

Zinc Alginate.—A colourless gelatinous precipitate formed on precipitating zinc sulphate by sodium alginate.

Analysis gave zinc 16.06 per cent.

The following formula requires 16.05 per cent.

$\text{Zn} = 65 \text{ C}_{7.6} \text{H}_{7.7} \text{Zn}_4 \text{N}_2 \text{O}_{2.2}$.

It will be observed that like the aluminium salt, the proportion of zinc is abnormal.

Zinc alginate is very soluble in ammonia, affording a colourless solution of zinc-ammonium alginate, which dries to a brilliant transparent film, insoluble in water. This solution may be employed for the same purposes as cuprammonium alginate; and substituted for it where the colour is an objection.

Cadmium Alginate, made by precipitating cadmium nitrate by sodium alginate, resembling the zinc compound, and is equally soluble in ammonia, the solution on evaporation giving an opaque white film, insoluble in water. This substance has not yet been examined.

Manganese Alginate is a colourless gelatinous precipitate obtained by the addition of sodium alginate to manganese sulphate in solution.

It is soluble in ammonia, forming a brown solution which dries to an olive-brown film, insoluble in water. This compound is still under investigation.

Chromium Alginate is a blue gelatinous precipitate, made by precipitating solution of chrome alum with sodium alginate. It is soluble in ammonia, forming a blue solution, which dries to a brilliant olive-green film insoluble in water. This substance is under investigation.

Sodium alginate mixed with a bichromate is sensitive to light in the same way as gelatine, the mixture becoming insoluble in water after exposure to light.

Uranium Alginate is a yellowish-brown gelatinous precipitate prepared by precipitation from uranium nitrate solution with sodium alginate. It is very soluble in ammonia, forming a deep yellow solution, which dries to a brilliant yellow film, insoluble in water. It may be useful as a varnish for optical purposes. This substance has not yet been examined.

Platinum Alginate is a brown gelatinous precipitate obtained by precipitating platinum chloride solution with sodium alginate. It is very soluble in ammonia, forming a yellow solution, which dries to a yellow film, insoluble in water. This substance is under investigation.

Silver Alginate.—The silver salt, usually pretty definite, is not so with alginic acid. It can scarcely be called an insoluble salt, as it is only precipitated in concentrated solutions, and even then incompletely. It is a colourless gelatinous precipitate, very sensitive to light and very soluble in ammonia, the solution drying to a dark reddish-brown film, which on exposure to light becomes a brilliant silver mirror, the metal being reduced on the surface. It ought to have some applications in photography, but its properties have not yet been investigated.

Tin.—*Stannous Alginate* is a white gelatinous precipitate obtained by precipitating stannous chloride with sodium alginate. It is very soluble in ammonia, forming a colourless solution, drying to a transparent film, insoluble in water.

Stannic Alginate is a white gelatinous precipitate obtained in the same way from stannic chloride. It is also very soluble in ammonia, forming a colourless solution, drying to an opaque white film, which is soluble in water.

Arsenic Alginate is a colourless gelatinous precipitate made by precipitating arsenic chloride with sodium alginate. It is soluble in ammonia, forming a colourless solution, which dries to an opaque film, quite soluble in water.

Antimony Alginate is a dense white gelatinous precipitate obtained by precipitating antimony chloride with sodium alginate. It is soluble in ammonia,

forming a colourless solution, which dries to a transparent film, soluble in water.

This and the three preceding alginates are under investigation.

Shellac Algin.—Shellac is soluble in alkalis, and therefore combines with the alkaline alginates. Any of these may be employed, but I have found the shellac ammonium alginate the best. A solution of ammonium alginate, combined with one-third of its weight of shellac, forms a light brown solution, which dries to a tenacious film, quite soluble in water. When this film is passed through a bath of weak hydrochloric acid it becomes insoluble, the alginic acid and the shellac being deposited together. A flexible sheet is thus formed having considerable strength, and much resembling sheet gutta-percha, which for some purposes it may replace, as, for instance, in bandages and dressings. Looking at the great brittleness of shellac, which destroys its value for many applications, no one would suspect its presence in such quantity in this very pliable sheet. Solutions of calcium or aluminium or other such salts may be used for the bath, and in these cases the resulting film will be a combination of shellac with calcium or aluminium, or other alginate.

It is obvious also that many other resinous substances, of which shellac is only an example, may be incorporated in a similar manner with a soluble alginate and then rendered insoluble.

Compounds of algin may also be obtained by precipitating an insoluble alginate with an insoluble phosphate, borate or silicate, giving a large range of new compounds.

Alginic acid also combines with many alkaloids, forming soluble films resembling those of ammonium alginate. Some of these may be useful in medicine, but I cannot say more about these bodies this evening, because none of them have been yet fully investigated, and because this paper has already obtained sufficient longitude, and perhaps latitude, for one evening.

The bodies of alkaloidal character which have been prepared and are on the table, are the alginates of quinine, aniline, chinoline, and toluidine, in reference to which I may have something to say on a future occasion.

DISCUSSION.

The CHAIRMAN said there was hardly one of the new substances mentioned that was not full of interest and suggestion. He would like to ask, firstly, if cotton could be dyed with aniline colours after being mordanted with algin; and, secondly, whether films—either of algin or its ammonium compounds—might be used as a photographic substratum to hold sensitive silver salts?

Mr. COLEMAN could fully endorse the Chairman's remarks. It seemed to him that very remarkable results had been obtained in making soluble, by the action of alginic acid, precipitants which were ordinarily insoluble. He would be glad to know whether any experiments had been made on the technical applications of algin compounds. He also looked forward to the author receiving some remuneration for the vast amount of labour he had given to the subject.

Mr. CHRISTIE said that twelve months since he had made some fairly successful experiments with a view to substitute alginate of soda for cow-dung in fixing alumina upon cotton goods, though at first he had found it difficult to prepare a salt which would completely precipitate the alumina. The author now told them that alginic acid was capable of forming soluble double salts with metals and ammonia, the corresponding simple metallic salts being insoluble.

It occurred to him (Mr. Christie) that instead of printing acetates and sulphates of alumina upon cotton cloths, and afterwards fixing them by alginate of soda or other dunging agents, the soluble ammonium and aluminium alginate might be used at once for printing, and the ammonia afterwards driven off by heat; thus avoiding a long and costly process, and yet obtaining the alumina in a suitable condition for dyeing. If he could be furnished with some of that soluble aluminium and ammonium salt, he would like to try it, and would report upon it at a future meeting.

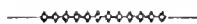
Mr. FULTON asked whether, in precipitating a solution of redonda phosphate by algin, the alumina alone would be separated, or whether iron alginate would go down with it. He regretted that during that portion of the paper relating to iron salts of algin he had been so occupied in examining some of the specimens that he had missed the point in question. The specific gravity of algin had been stated to be little less than that of ivory; he would be glad to know how the two substances compared in regard to elasticity?

Mr. STANFORD, in reply to the Chairman, said that as yet he had not been able to investigate the relations between aniline colours and algin compounds in regard to cotton, but might mention that the blue sheets of alginic acid on the table were coloured by Mulhouse blue. In regard to photography, he had already mentioned that though the silver salt of algin was very sensitive to light, yet it was by no means definite, and in addition was partially soluble in water. In photography, algin would more probably be employed with bichrome in the same way as gelatin, over which it had certain advantages.

With regard to the precipitation of aluminium alginate from a solution of redonda phosphate, it should be remembered that the advantage of algin over other precipitants was that alginic acid only acted on aluminium in an acid solution. It would, in all probability, also bring the iron down with it.

As regards elasticity, no doubt sheets of algin were very elastic, but he had not yet tested the material in blocks.

Mr. Christie had made a very valuable suggestion as to the employment of aluminium alginate dissolved in the first place in ammonia, and afterwards rendered insoluble, and care should be taken to supply him with large samples for his experiments. The fact was that he had been quite unable to meet the demands upon him for this substance up to the present, though in two or three months he trusted that he would be able to satisfy everybody.



ON THE ACTION OF POTASH ON RESINS.

BY EDMUND J. MILLS, D.S.C., F.R.S.

MOST resins consist in the main of one or more acid bodies, capable of taking up bromine, and also capable of acting upon potash in such a way as to form saline compounds. Bromine absorptions for all the principal resins have been previously published (*Journal*, 1885, 96); in the present paper, a series is given of potash absorptions.

The method of determining the potash absorptions was as follows:—A suitable quantity of the finely-powdered resin was introduced into a stoppered bottle, having a capacity of about 100cc., and a decided excess of normal alcoholic potash was run in. The bottle having been closed, was well shaken, and then allowed to stand for about eighteen hours. In many cases, however, such prolonged contact was not really necessary, but for the sake of uniformity it

was adopted in every case. When the specified time had elapsed, a little phenol-phthalein was added to the liquid, and the titration was completed with the aid of normal hydric chloride in the ordinary manner. At least two determinations were made in each case. The following table contains the results. It includes, also, a column of bromine absorptions for the same samples, and the calculated numerics of the resins on the suppositions that they are pure and monobasic. These suppositions are very nearly correct in the case of good rosin, but, probably, only approximately so in the other cases:—

POTASH ABSORPTION OF RESINS.

RESIN.	Potash %	Bromine %	Numeric.
Rosin, refined	18.10	112.70	308.62
Shellac, bleached	18.20	161	306.92
„ not bleached	23.01	5.21	242.76
Gum, Benzoin	22.31	38.90	—
„ Amber	16.07	53.53	347.60
„ Animé	9.54	60.22	585.51
„ Gamboge	15.47	71.56	361.09
„ Copal	12.39	[89.93]*	450.85
„ „ reduced to $\frac{1}{4}$ by boiling	12.89	[84.52]*	433.36
„ Sandarac	16.40	96.42	340.61
„ Kauri	12.88	108.22	433.70
„ Thus	21.03	108.51	265.62
„ Dammar	5.23	117.91	1068.07
„ Elemi	3.29	122.23	1697.87
„ Mastic	11.67	121.33	478.66

* Determined on other samples.

From the above table it appears that, in a few cases, the potash absorption is inverse to the bromine absorption; but, on the whole, there is evidently no systematic connection between them.

The action of alcoholic potash takes place very easily with the following resins—viz., rosin, lac, benzoin, thus, elemi; easily with kauri and mastic; less readily with the rest. Rosin, lac, animé, sandarac, thus, and mastic dissolved completely or almost completely.

The potash absorption, considered by itself, exhibits a feature of singular interest. If we arrange its values in arithmetical order, they fall into seven well-defined groups. (See table on next column.)

[In these groups, common shellac and gum benzoin do not appear, on account of their containing decided amounts of non-resinous bodies.] The potash absorptions are clearly multiples by a whole number of a fundamental constant nearly equal to 3. It may be theoretically deduced from that of pure rosin ($C_{20}H_{30}O_2 : KHO = 18.492$ p.c.) by dividing by 6, which gives 3.082 for the value of the constant. From this number the above calculation has been made; and it evidently agrees with experiment. It may be otherwise calculated by dividing the experimental potash absorptions by 1, 2, 3, etc., and taking the most probable value of the resulting quotients; the deduced constant is 3.075. It is evident, then—whatever the proximate composition of the natural resins may be—that they are in effect a series of polymers of a body $C_{20}H_{30}O_2$, a formula that does not admit of further division. The proximate composition has, in fact, been in many cases partially

examined, and the constituent resins are invariably found to correspond closely in their formulae with such polymers. Great stress, it is true, cannot be laid upon the results of these examinations. Alcohol and alcoholic potash,—the discriminating agents chiefly employed,—are not likely to leave entirely unchanged a resin with a high numeric, and there may be some natural oxidation; indeed, the whole subject requires, and would well repay, an ample revision. What can be alleged with much certainty is, that the natural resins are, *in effect*, a simple series of polymeric substances.

Group.	Resin	Potash, per cent.	Potash, per cent. cal.
I.	Thus.	21.03	21.57
II.	Rosin.	18.10	18.48
	Shellac (bleached).	18.20	„
III.	Amber.	16.07	15.10
	Gamboge.	15.47	„
	Sandarac.	16.40	„
IV.	Copal.	12.39	12.32
	Kauri.	12.88	„
	Mastic.	11.67	„
V.	Animé.	9.54	9.21
VI.	Dammar.	5.23	6.16
VII.	Elemi.	3.29	3.08

MIXTURES OF RESINS.

The qualitative analysis of resins, like the qualitative analysis of oils or fats, leads to hardly any satisfactory result. Questions of this kind are best approached from the quantitative side. I have, therefore, thought it worth while to ascertain whether, in a mixture of resins, the potash absorption is altered in proportion to the amount of admixture.

Experiment I.—A mixture of equal weights of bleached lac, animé, and dammar was made, and its potash absorption found to be 11.05 per cent. The mean of the three experimental numbers is 10.99 per cent.

Experiment II.—Equal weights of bleached lac, boiled copal, and dammar were mixed, and the mixture absorbed 11.72 per cent. of potash. According to the table the percentage should be 12.11.

VARNISHES.

The numbers adduced in this paper will prove of value in the analysis of varnishes, an operation which sometimes presents almost insurmountable difficulties. The volatile solvent—such as ether, alcohol, turpentine—is easily determinable by simple evaporation with water; driers can usually be estimated after ignition. Most of the problems are due to the resins.

The following experiments show that the potash absorptions of a resin is not altered in presence of boiled oil.

Experiment I.—A sample of boiled oil was titrated with alcoholic potash in the cold, and found to take up 3.22 per cent. A sample of pale French resin absorbed, on gentle heating, 18.15 per cent. A solution was prepared containing 25.46 parts of resin in 74.54 of boiled oil; a blank experiment for loss was simultaneously performed upon the boiled oil, the temperature not being allowed to exceed 120°. The boiled oil in the blank experiment lost 3.35 per cent. Allowing for this and acidity, the potash absorption

in the cold (in presence of a little ether) was found to be 18.76 for dissolved resin.

Experiment II.—A similar experiment was carried out with a mixture of 87.92 parts boiled oil, and 30.68 parts of boiled copal (potash absorption, 11.44 per cent.). The absorption for the dissolved gum was found to be 11.64 per cent.

It is evident that boiled oil, when heated with a resin, makes no alteration in the resin's acidity.

Let us consider a case in which we have removed the volatile solvent from a varnish, and have to deal with a residue containing only two resins and boiled oil. Such a residue is perhaps the one that most frequently occurs. First, to a portion of it add enough ether for solution, or nearly complete solution, and at once titrate in the cold with alcoholic potash; this gives the potash absorption due to the resins. Secondly, to another portion add excess of alcoholic potash, cohobate as in an ordinary saponification experiment, cool, and titrate; this gives the potash absorption due to all three constituents. If r , c , and b be the respective weights of the first and second resins, and of boiled oil in a gramme of the residue, α , β , and γ , the potash absorption per gramme of these substances respectively; P , the potash absorption of one gramme of the residue before cohobating, and Q after cohobating, we shall have—

$$\left. \begin{aligned} 1 &= r + c + b \\ P &= \alpha r + \beta c \\ Q &= \alpha r + \beta c + \gamma b \end{aligned} \right\}$$

Hence

$$\left. \begin{aligned} b &= \frac{Q - P}{\gamma} \\ r &= \frac{\beta(1 - b) - P}{\beta - \alpha} \\ c &= 1 - b - r \end{aligned} \right\}$$

It is assumed that the boiled oil has no acidity. If there is reason to suppose that it is acid, 1 per cent. of potash may be taken as an approximate allowance.

In the important case of a varnish containing rosin (r) and boiled copal (c), the value of α is .1848, of β .1232, and of γ (deducting 1 per cent. for acidity) .1875. The equations become—

$$\left. \begin{aligned} b &= 5.3333 (Q - P) \\ r &= 16.234 \left\{ P - .1232(1 - b) \right\} \\ c &= 1 - b - r \end{aligned} \right\}$$

The results thus obtained may be checked by accurately determining the specific gravity of the varnish, and calculating it from the analytical data. There should be a fair agreement. An error of 1 per cent. in the allowance for acidity of boiled oil corresponds (in a residue containing one-third of it) to an error of 1.76 per cent. in that residue. The error will be proportionately less on the varnish, and is, therefore, not of any great importance.

The following data are necessary in calculating the specific gravity, at 15°, of a varnish containing boiled copal, rosin, boiled oil and turpentine.

Specific gravity of dissolved boiled copal	1.073
rosin	1.075
boiled oil (apart from driers) ...	.935
turpentine .....	.864
litharge.....	9.363

If a decided amount of litharge be present in the form of linoleic soap, it must be determined and multiplied by the factor 3.1868, in order to calculate the amount of soap. As this soap has no potash absorption, its weight must be deducted from the residue before calculating the weight of C from the equation last given. If other driers have been used, suitable corrections must be similarly made for them. I have obtained good results by this method.

DISCUSSION.

MR. STANFORD was very much surprised to see this sample of sylvic acid, and to understand that it could be obtained so easily and directly from resin. It was very remarkable, and he would like to ask Prof. Mills how many crystallisations from alcohol were necessary to obtain the acid in a pure state?

Prof. MILLS, in reply, stated that two or three crystallisations were sufficient, provided the resin was very old, as new resin crystallised very slowly indeed.

Nottingham Section.

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Hon. Local Secretary:

J. R. Ashwell, Midanbury Lodge, Bentinck Road, Nottingham.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held Friday, 12th February, 1886, in the Chemical Theatre of University College, Nottingham.

PROFESSOR CLOWES IN THE CHAIR.

FILTRATION AND WATER SOFTENING.

BY P. A. MAIGNEN.

THE impurities in water may be divided into two classes—namely, those in suspension and those in solution. To remove the suspended matters on the large scale, sand alone has stood the test of time. It is a very rough filtering medium, but it has the advantage of being cheap. Without entering into details of the composition of the sand beds made by the water companies, suffice it to say that the filtration obtained in this way is but partial. It cannot remove all the finest suspended impurities, such as the specific germs of typhoid fever, as was unfortunately shown in the case of the Bangor epidemic. The frequency of diarrhoea in hot seasons is in great part owing to this defective system of filtration. Domestic filtration was until a few years back considered a delusion and a snare, and many scientific and sanitary authorities have been profuse in their condemnation of domestic filters. For it must be remembered that if a filter does the work for which it is intended, that of retaining the impurities of water, these must be removed periodically, or they contaminate the water instead of purifying it. It is a notorious fact that domestic filters of the old types were constructed on the principle “of giving no trouble to the users,” “of being self-cleansing,” or “of not requiring any attention for years.” The worst defect of these old-fashioned filters is that they contain portions which are cemented or otherwise sealed down; and fixed filtering media, such as charcoal blocks, porous stone or clay, the inside pores of which cannot be cleansed without rendering the filter perfectly useless.

The next point of importance, in speaking of filters, whether for domestic or industrial use, is efficacy.

Among the suspended matters in water there are very small inorganic particles, and some living micro-organisms which are smaller still. These can only be removed by a filtering medium which is finer than, or at least as fine as, the impurities themselves. Sand does not possess that quality, neither does coarse charcoal; the voids between the particles of the filtering medium are too large to arrest the microscopical impurities. We say nothing of sponges, wool, or similar organic matters, as they are known to decompose rapidly, and to be either too expensive for constant renewal, or insufficient to purify water. Charcoal blocks, porous stones, or biscuit china have fixed pores, which are either too large, and allow the water to pass too freely—or too small, when the water does not pass at all, or passes in too small quantity; moreover, the action of these media is purely mechanical; while none of these filtering media are capable of arresting more than a trace of matter in solution.

Whilst speaking of the purity of the filtering medium, I would point out to chemists one valuable use they can make of my invention. When ordinary filtering papers are used in funnels, they have to be washed with weak acids to remove impurities. By my process the filtering paper is reduced to a pulp, washed until no impurity remains in it, and then it is used so as to make on the filtering surface, as it

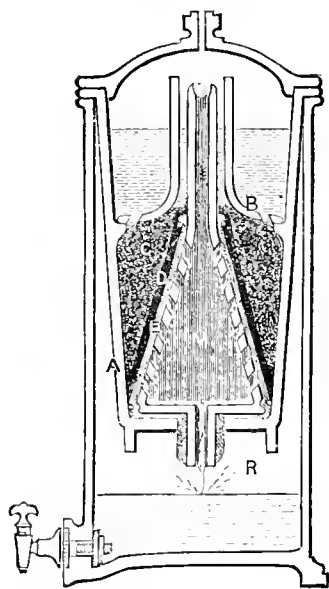


FIG. 1.

were, a thick piece of paper felt. Thus not only is a pure filtering material formed, but also a very effective filter; wherever there is a pore larger than another, a floating particle of paper, following the current, goes to mask the pore, and then the filtering layer is even and equal everywhere. The materials which I employ for the filtration of water are—

I. Pure asbestos cloth.

II. A filtering material which consists of finely-powdered well-burnt animal charcoal, the soluble matters of which have been extracted with weak acetic acid. After repeated washings it is boiled in lime-water; this not only clarifies the water, but also removes organic matter and metallic salts in solution. The filter is very easy to cleanse.

Fig. 1 shows a section of these filters at work. R is the reservoir for the filtered water. It is accessible for cleansing, as the filter-case proper

simply rests loosely on it. M is the filtering frame covered with asbestos cloth E, tied with asbestos cords. D is a layer of powdered charcoal, deposited automatically by being mixed with the first water poured upon the filter. C is granular charcoal put in loosely to fill all the available space between the layer of the powdered material and the screen B.

The water being put into the filter, passes first through the granular charcoal, then through the layer of powdered charcoal, and lastly through the asbestos cloth, issuing into the hollow filtering-frame M in a most minute state of division, and it falls perfectly pure and aerated into the reservoir R. It will be seen that this new filter differs entirely from anything which has ever been introduced before, and that the water is not only purified, but also oxygenated, and rendered brisk and pleasant to drink.

About every six months, in this country, the filtering medium should be removed and replaced with a new charge. Now it should be observed that, unlike purely mechanical filters, this exerts an absorptive and chemical action, as is shown by water contaminated with sewage being rendered perfectly pure, as judged by the permanganate test; lead, copper, zinc, and iron are also removed, and claret is turned into a colourless liquid. This may be explained by the action of the oxygen gas condensed in the pores of the charcoal, which not only oxidises the organic matter, but also the metallic bases of the dissolved salts, forming insoluble oxides which are arrested mechanically. The peculiar smell which is found in the liquid obtained from claret is indicative of an aldehyde, proving that the alcohol has been oxidised.

You will observe that not more than one inch of the granular charcoal is above the layer of the powdered charcoal in the filter on the right, whilst as much as six inches of the same material are in the filter on the left; but in this latter filter there is no asbestos cloth nor powdered charcoal. Yet the first *does* arrest dissolved impurities and the second *does not*. This proves what we have urged at the beginning of this paper—that a granular or coarse filtering medium alone is incapable of filtering water properly.

I proved long since that a thin layer of fine material is more efficacious in purifying water than a thicker layer of coarser material. Sir Frederick Abel, at the conclusion of the Conference on Water Supply at the International Health Exhibition, after alluding to the various methods of water purification, said:—“With regard to other methods of purifying water, considerable improvements have been effected in recent years in the application of filtering media—such, for instance, as charcoal preparations in a more or less finely divided condition. . . . There could be no doubt that the action of charcoal as a purifying agent, quite apart from its action as a simple filtering agent, was much promoted by constantly renewing the surface of contact between the charcoal and the water, and so he would imagine that filtering on the principle devised by M. Maignen would act more efficiently and rapidly than the mere passage of water through charcoal *en masse*.”

We have seen that the finest impurities in suspension, organic matter in solution, nitrates and nitric acid, also metallic salts in solution, are removed by filtration through our filters (and as far as we are aware by no other filtering medium), but as we said at the beginning of this paper, something more is required to remove the dissolved earthy salts. All water which contains more than seven grains of mineral matter per gallon is considered *hard*. The substances which render them hard are commonly carbonate of lime and sulphate of lime. The suitability of a very hard water for drinking purposes is questionable, but it is undoubtedly unsuitable for

washing purposes. The loss of soap owing to this cause in London alone is estimated at half-a-million sterling yearly. About two pounds of soap is wasted for every 100 gallons of water used in washing. When soda or washing powders are introduced in the washing tub, a certain economy of soap is effected, but a considerable deposit is precipitated on the linen. By softening the water previous to its use, not only is there a much greater saving, but the linen is better washed, and not damaged in any way. The salts of lime and magnesia thrown out of solution by soap or soda, interfere with the weaving and dyeing operations.

It is, perhaps, in steam boilers that the greatest troubles have been experienced. No less than 160 substances have at different times and in different places been introduced into boilers to prevent the formation of scale. Some of these substances convert the lime salts into mud instead of hard crust, but they do not get rid of the mischief, and in many cases they introduce evils greater than those they are designed to palliate. The water ought to be softened *previous to its use*, and not inside the boiler.

Many attempts have been made to soften water; but the only process which has stood the test of time is that of Professor Clark, who, in 1841, discovered that the addition of lime-water to hard water produced the same effect as boiling—that is, it drove out of the bicarbonate of lime the excess of carbonic acid which was holding the salt in solution, and the simple insoluble carbonate of lime or chalk was precipitated. This process only affects the bicarbonates, and being unable to remove sulphate of lime, must be accounted an imperfect one.

My process, which is intended to remove this imperfection, was very clearly described by Mr. Baldwin Latham, C.E., in his paper read at the Conference on Water Supply, held at Kensington during the International Health Exhibition. (See *Society of Arts Journal*, August 15, 1884, vol. xxxii. p. 927.)

I have combined in *one powder*, the three reagents,

Quicklime,
Carbonate of Soda,
Alum,

in proportions which vary according to the composition of the water to be softened. This is prepared in a very finely powdered and anhydrous state, and it is introduced into the water either by hand or by an automatic apparatus. On introducing this powder into the water, the lime acts on the bicarbonates in the same manner as in Clark's process, with this difference, however, that the trouble and expense of making lime-water is saved, and the exact quantity of lime which is required to produce the desired effect is employed. Whilst the carbonates are thus thrown down by the lime, the carbonate of soda dissolves, and removes the sulphate of lime by double decomposition, precipitating the lime as carbonate, and leaving sodium sulphate in solution. For a water like that of London, which has a hardness of 15°, about 18 grains of the powder per gallon are used. This is equivalent to one ounce for twenty-five gallons.

For softening large quantities of water, either one or more tanks large enough to hold twelve hours' supply are required, so that the water may have an absolute rest of a few hours to clarify itself after it has been softened; or a complete softening plant, which consists of an automatic feed-apparatus, softening and settling tank, and filter, may be employed. The powder is put daily or weekly, as the case may be, in the hopper G. As the water comes in through the ball-tap E, it rises over the water-wheel F in B. The motion thus given to the wheel starts a mill in the hopper, which delivers, through a

regulating door, the exact quantity of powder that is necessary to produce the degree of softness desired. Thus, if the water comes in fast, the powder falls fast into the water, and *vice versa*.

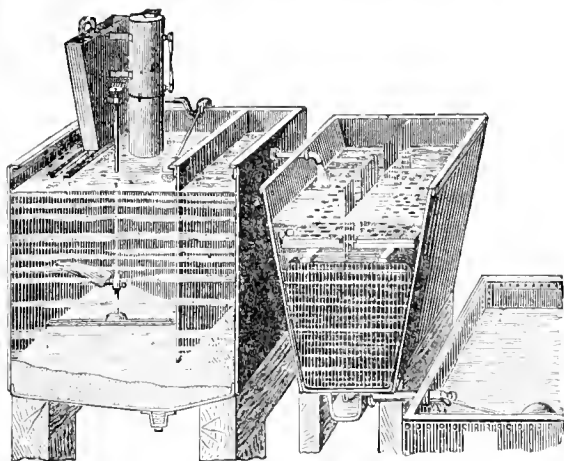


FIG. 2.

The chemical action is complete in about one hour, and when it cannot be allowed to settle by itself, which would be a matter of a very few hours, a filter may be used to arrest the suspended matter. This process is found to be very simple and easy of application.

DISCUSSION.

The CHAIRMAN said that there were many interesting points in the paper they had just heard, several of which were well worthy of discussion. The meeting would have the advantage of hearing the opinions of some of those present who were experts on this subject. The "Filtre Rapide" seemed to have one great recommendation, viz., that it could be easily cleansed by heating the asbestos cloth and renewing the charcoal.

Mr. M. O. TARBOTTON asked how far the system could be applied on a large scale. Water treatment came under two heads—purification and softening. Science had laid down a course of treatment to secure the former, but the latter presented many difficulties. Nottingham water varied in hardness from 7 to 22 degrees, one-fourth of which was permanent. Waters up to 16 degrees of hardness were not unwholesome to drink: but for manufacturing purposes a soft water meant a saving of about 2½ lbs. of soap for every 100 gallons used. He himself was quite satisfied with Clark's process, but should like to make himself further acquainted with the one before them.

Mr. JOHN HARDISTY asked if the author could give them an estimate of the cost of his process on the large scale, such as for softening "feed" waters, comparing it with other processes per given "indicated horse power"! He would also like to know whether soft water drinking caused softening of the teeth and bones?

Dr. HANDFORD said that nearly all waters contained sufficient earthy constituents to maintain the teeth and bones; but hard waters were apt to cause gastric derangements. In Glasgow and Liverpool there had been a marked improvement in this respect in the public health since they had acquired a soft supply. The process before them did not claim to remove magnesia, salts, and chloride of calcium, yet these were among the most objectionable constituents of potable water—"goitre" had been attributed by some to drinking water impregnated

with lime-salts. It certainly was prevalent in some limestone districts. For instance in Oude, on granite and gneiss, 2 per cent. of the population were affected; on mica slate and hornblende rather more; on clay slate, 5·4 per cent.; on green sand, none; while on limestone, 33 per cent. suffered from the disease. In Switzerland, "goitre" was common where neither magnesia nor lime-salts abounded, and seemed most prevalent where iron pyrites and metalliferous rocks were present. As to domestic filters, many medical men objected to them *in toto*, because it was impossible to ensure their being constantly cleansed; and because it was considered that the public ought to be able to depend on the purity of their water supply without being asked to purify it themselves. The filtration of water on a large scale was a different matter, and well worthy of consideration. Dr. Percy Frankland had for some months past daily examined, by the new gelatin process (see *Journal*, Dec. 1885), the water of one or two of the London Companies, before and after filtration. He found that large sand-filters diminished the number of living spores from 80 to 90 per cent. Spores lived in pure water, and might pass through a filter which would stop bacteria. Did, however, these filters stop bacteria?

Professor BLAKE noted that the author claimed for his apparatus the power of separating particles of organic matter. But could it also deal with the organic matter in solution?

M. MAIGNEN said that he would show by experiments that it could.

Mr. J. B. COLEMAN took exception to the statement that the lime in the softening mixture acted first, for were not the alum and soda more soluble? They had better omit the alum if its only use was to hasten precipitation. In Dublin, where a softer supply of water had recently come into use, there was an undoubted increase of defective teeth among the children.

Mr. R. LLOYD-WHITELEY said that the meeting should have been furnished with more explanations as to the uses of the various constituents of the softening powder, especially as to the alum. As far as he could see, the mixture would be just as good without it. What they wanted was some practical means of softening large quantities of water for manufacturing purposes.

Dr. WHITELEGGE asked what was the amount of organic matter and the number of organisms in solution before and after the process? The author should also have given more details as to the amount of solids removed by his filtration process. The removal of lead ought not to be left to the haphazard chances of domestic filtration; and a water supply containing ever so small a proportion of that metal ought to be condemned for drinking purposes. Where also the supply was soft and likely to take up lead from the fittings, special precautions should be devised to prevent danger from such a source; but if people would only run to waste the first water they drew in the morning, there would be an end to lead poisoning. In Sheffield, however, they were trying the experiment of adding a little lime to harden the water in their reservoirs, so that there would be less chance of its acting on the fittings. The Nottingham supply was so good that domestic filters were unnecessary, but he thought that there was room for them in outlying villages where the quality of the supply was very bad. As to the relative merits of hard and soft waters, he thought that a moderately hard water did no harm, and it certainly had the advantage of being palatable. The so-called "chalky" deposits, characteristic of gout, contained neither lime nor carbonic acid, but consisted mainly of urate of soda.

Would the author offer some explanation of his statement that his filter removed permanganate of potash from solution in water? It seemed almost incredible.

Mr. W. J. ABEL said that so long as the disease germs were removed from water that was all that was necessary to secure a wholesome supply, but Dr. Frankland's experiments went to show that filtration did not completely accomplish this.

Mr. LEWIS T. WRIGHT said that "goitre" was often attributed to drinking snow water. In London there were two classes of water drunk—deep well water and river water. If one was hard, the other was under suspicion of contamination, so that it was merely a choice of evils.

M. MARGEN, in reply, said that he could hardly explain all his results; he could only say that such results did occur. He had letters from firms who had been using his process for their "feed" waters, and their experience was that no scale whatever was formed on the boilers. It was true that they might not want his filters in Nottingham, but there were plenty of country places where they would be of great use. Surely if his filtration process would remove the colour of claret, it would remove spores and germs.

—♦♦♦♦♦—

Mechanics' Institute, March 6.

PROFESSOR CLOWES IN THE CHAIR.

SOME NOTES UPON DYED HOSIERY AND ITS RELATION TO SKIN IRRITATION.

BY JOHN R. ASHWELL.

Introduction.—The fact that "blood poisoning," or "skin irritation," has been stated to be caused by wearing dyed hosiery next the skin, is one which some people in Nottingham and the neighbourhood have from time to time seriously to combat. To most people the subject is of interest, I venture to think, because they have worn dyed hosiery for many years without experiencing any ill effects. I have been asked to lay before you to-night some of the points which should be understood and carefully considered before any charge of skin irritation is preferred against dyed hosiery. Probably no fabric is so universally worn next the skin as hosiery, and there are some conditions attending the dyeing and finishing of hosiery which I believe are without any parallel in the case of other dyed fabrics. At the outset, let me be clearly understood what is meant by the term "dyed hosiery." This term *is not* meant to cover such hosiery fabrics as are made from dyed yarns; but it *is intended* to cover such coloured hosiery fabrics as have been dyed *after being manufactured*. The limitation is important.

Its effect is to remove from our notice some of the highest qualities of hosiery, of which the quantity is small, and being made from dyed cotton or wool yarns, are distinguished frequently by two or three fine stripes of white cotton or wool at the welt, as well as by a white toe and heel; or which are made from dyed cotton or dyed wool yarns wrought into stripes, etc. These yarns are dyed throughout England, whilst "hosiery dyeing" is a trade carried on in a very limited area around Nottingham and Leicester.

It will be my endeavour to-night to lay before you some of the principles involved and materials employed in dyeing hosiery. I shall endeavour to accomplish this on broad, general lines, avoiding detail, and grouping colours together according to the mordants and dyestuffs employed. It will also be

necessary for us to form some idea of the condition in which the dyes exist upon the fibres, as well as those conditions which obtain when hosiery is worn.

1. *Dyed Hosiery*.—The main bulk of dyed hosiery consists of fabrics made of wool, cotton, and mixtures of wool and cotton known technically, and according to quality, as "merino," and as "shoddy." The chief points to be desired in dyed hosiery are—(1) cleanliness in wear; that is, neither staining the skin nor underclothing; (2) resistance to washing; that is, the colour should be capable of resisting such combinations (cold or hot) of soap or alkali *which the laundress chooses to employ*; (3) permanence of colour; that is, the colour must keep in stock for two or three years without material alteration in colour; (4) the dye must not materially interfere with the elasticity and softness of the original fabric—four conditions with which very much of the dyed hosiery does not comply. Without doubt, dyed wool hosiery complies the most completely. Mixed wool and cotton, or merino hosiery, complies far more completely than does cotton hosiery; although some colours on cotton leave but very little to be desired.

Among the colours applied to hosiery fabrics there is a noteworthy absence of mineral pigments, produced by the precipitation of hydrated metallic oxides or of metallic salts—*e.g.*, manganic oxide, chromate of lead or manganese, Prussian blue, copper arsenite, etc. Possibly the only exception is that of ferric hydrate, and even this is never used as a self-colour. The insoluble red woods—barwood, camwood, etc.—are not employed when fabrics have to be dyed, although used upon unspun fibres which find their way into hosiery. All colours which possess very slight resistance to light and soap are avoided in self-defence by the dyer.

2. *Mordanting Cotton Hosiery*.—With but very few exceptions, almost the whole of the cotton hosiery is subjected to a mordanting process; indigo-blues and some light shades dyed by the "stuffing and saddening" method are the chief exceptions. The mordanting process consists in impregnating first with a solution of some tannin matter, and afterwards with an excess of a solution of some metallic salt. By this means an insoluble tannate is obtained within the fibre, and serves as a mordant for the various colouring matters subsequently applied. Before the colouring matters are applied, the mordanted fabric containing an excess of the soluble metallic salt is subjected to a very severe process of rinsing, in which cold water and friction are combined. The water removes the soluble metallic salt, whilst the friction is necessary to remove any loosely adhering precipitates, such as form on diluting a solution of stannous chloride, or which "hard" waters form with many solutions of metallic salts.

Tannic acid, galls, sumac, black and cube cutch, together with various extracts, are largely employed as tannin matters. Ferrous sulphate, crude ferrous acetates, various "nitrates of iron," stannous and stannic chlorides, stannate of soda, cupric sulphate alum, and bichromate of potash are the most largely employed metallic salts. The insolubility of the metallic tannates and their adherence to the fibres are both, of necessity, very complete, in order to withstand the combined action of friction and cold water. These two conditions are of importance when the possible absorption of the tannate as a whole, or in part, by the skin is considered. In self-defence, the dyer errs on the side of over-rinsing his goods before dyeing, in order to secure a level colour, etc.

The tannates of tin and iron, alone or combined, form the mordant upon which almost all colours dyed upon cotton hosiery may be produced. Tannates of tin are used as mordants for bright reds, wine colours,

light and dark blues and greens, and many light bright colours obtainable from "basic" anilines, either with or without dyewoods. This use of tannate of tin upon cotton hosiery dates from a period which is far beyond the recollection of any now in the trade.

It is found that such a "tannate of tin," as it exists upon dyed cotton hosiery, is decomposed by alkaline perspiration. The perspiration becomes acid, gives a precipitate with gelatine, becomes dark coloured on standing, and behaves as if tannic acid had passed into solution; but such a solution contains *no trace* of tin. Tannate of tin, as it exists in dyed cotton hosiery, has stood the most searching test of time and experience in wear; so that it is most difficult to see how any charge of skin irritation can be laid against it.

Tannate of iron is very largely used for the production of blacks with logwood. Its use for this purpose upon hosiery is old. It has stood the test of time and experience in wear; and when we remember M. Bousingault's figures (*Compt. Rend.* 74, 1355—1359), estimating the quantity of iron taken daily by a man in food and drink at from 0.591 to 1.09 gm., it becomes difficult to see how insoluble salts or oxides of iron may be justly charged with skin irritation.

"Double tannates of tin and iron" are used for the production of dark colours from various "basic" anilines. A much-used process is to mordant with tannate of tin, rinse, dye with the "basic" coal-tar colour, and then darken with some salt of iron.

In actual practice, almost all colours in which "basic" anilines are employed, may be produced by judicious mordanting with tin or iron tannates, or both. This being so, I shall take a few colours which typify the whole, and deal with them in detail.

3. *Dyeing Cotton Hosiery: Browns*.—Almost all browns, from light tans to dark seal-browns, upon hosiery, are derived from cutch or gambier. Dark seal-brown, which is fairly typical of these colours, is produced as follows:—The hosiery is "poled" in a hot bath of cutch, cupric sulphate, and logwood, lifted, and put through hydro-extractor; then treated with a hot solution of bichromate of potash, and afterwards with a salt of iron, or the iron-salt may precede the use of bichromate of potash. These operations are repeated as a whole, or in part, till desired shade is obtained. Such processes were not in use for hosiery dyeing before 1850, although well known in other departments before that date. Colours produced upon hosiery by such methods vary far less than a mere analysis of ash would indicate. The first table on page 228 gives four analyses of ash from different dark seal-browns upon cotton hosiery. These give an average of 17.45% Cr_2O_3 , 15.400% Fe_2O_3 , and 19.75% CuO , calculated upon the weight of unburned hose.

Cotton hose dyed seal-brown become weighted, and thereby the softness and elasticity of the fabric become diminished.

In the ordinary process of washing by a laundress the colour is reduced in depth, and much of the oxides present is removed. I have known test-cases where goods (without being worn) having been washed ten times with soap, without addition of alkali, will lose 5.35% in total weight, including 93.76% of CuO , 18.49% of Fe_2O_3 , and 25.13% of Cr_2O_3 present upon unwashed hose. Such losses during careful but severe washing are significant, and I hope at some future time to give other and more extended figures. However, the length of time—thirty-five years—during which such colours have been dyed upon hosiery, as well as the enormous quantity yearly produced, gives great force to the conclusion that these colours cannot be called skin irritating.

Blacks.—The methods for dyeing black upon cotton

hosiery vary very greatly, although the materials employed upon the great bulk vary very slightly. Tannate of iron is the mordant upon which large quantities are dyed with logwood, with very rarely an addition of some old fustic. Sometimes cupric sulphate is used after dyeing with logwood, in order to get certain effects. Tannin matters, such as galls, sumac, cutch, are sometimes used upon better-class

greens or wine colours the principles employed are pretty much the same. The mordanted goods are dyed by machinery with a suitable mixture of "basic" anilines, rinsed in cold water, dried, and then soaped. Logwood is sometimes used along with or after the "basic" anilines, and then a little alum is used. Sometimes goods are treated with a solution of tannin matter after dyeing with the "basic"

WEIGHT OF HOSE.	Cr ₂ O ₃	Fe ₂ O ₃	CuO.	REMARKS.
51·320grms.	·0106grm. = ·0206	·7532grm. = 1·4676	·1650grm. = ·3215%	The dyestuffs used were Cutch and Logwood upon all.
25·171grms.	·077grm. = ·3059	·3115grm. = 1·3566%	·015grm. = ·0595%	All the colours were rich dark-seal browns.
28·002grms.	·086grm. = ·3013	·3864grm. = 1·3754%	·0037grm. = ·0131	} Much darker than usually met with
16·6238grms.	·0328grm. = ·0703	·9111grm. = 1·9605%	·1846grm. = ·3959%	

blacks, and frequently such blacks are "bottomed" with indigo. Where cutch is used, cupric sulphate and bichromate of potash are also employed, as well as some iron-salt and logwood. Frequently the dyeing operations are repeated, in order to obtain greater solidity in appearance, as well as durability of colour. The following are five analyses of ash from black cotton hose:—

anilines; this is useful in making the colour faster.

The coal-tar colour used may be divided, *for our purposes*, into two classes. (1) Those in which arsenic is employed in the manufacture, *e.g.*, Magenta. (2) Those in which arsenic is not used.

Under the term "Magenta" I include Magenta proper and those residues variously known as cerise,

WEIGHT OF HOSE TAKEN.	Fe ₂ O ₃	CuO.	REMARKS.
55·748grms.	1·0826grms. = 1·942%	none	The first two have an indigo "bottom," the others have not. The better qualities are at the top, and the poorer qualities are lower.
52·351grms.	·902grm. = 1·7229%	none	The better qualities have more tannin and less log- wood upon them than the poorer qualities.
46·180grms.	·559grm. = 1·215%	none	
47·612grms.	·4859grm. = 1·025%	trace	
51·273grms.	·5188grm. = 1·012%	·0527grm. = ·102%	

These give an average of 1·383% Fe₂O₃.

The metallic oxides are largely removed by mere process of washing with soap. I have known 32·92 per cent. of the iron oxide present, so removed by washing ten times without ever being worn; but as the black was common in quality the colour was greatly reduced.

Colours in which Coal-tar Dyes are employed.—For light and bright shades tannate of tin may be employed, but for darker shades the "double tannate of tin and iron" is much used. The dyewoods employed are logwood, and sometimes old fustic. For blues and greens, varying from sky to navy blue, or peacock to myrtle green, the following colouring matters find most demand:—Ethylene and methylene blues, indulines, benzylated rosaniline violets, together with methyl green and benzaldehyde greens. For wine colours varying from bright reds to claret the following find most demand:—Magentas, Safranines, Methyl Violets, Bismarck brown, and Auramine. Whether it is desired to produce bright or dark-blue

Grenadin, "Aniline brown," Maroon, etc., which contain more or less Induline and Phosphine in addition to Magenta.

To admit the presence of Arsenic in Magenta is popularly equivalent to saying that Arsenic exists in hosiery dyed with Magenta. So far as dyed cotton hosiery is concerned, nothing is further from fact, and as to woollen hosiery, so little Magenta of either kind is used for hosiery fabric dyeing that it may be ignored. In 1872 Dr. Springmühl ("Die Chemische Prüfung der Künstlichen Organische Farbstoffe") gives fourteen analyses of magenta for arsenic; the arsenic then found varied from 6·5 to 0·25 per cent. During the past six years it has not been my lot to meet with "magentas" containing more than ·237 per cent. of arsenic, and the average of several analyses shows ·0804 per cent. As. A magenta largely used in dyeing contains ·021 per cent. of Arsenic. Cotton hose mordanted with tannate of tin, rinsed, dried, soaped, and redried do not, on analysis, show the slightest inclination of arsenic (for the method em-

ployed see *Chemical News*, xliii. p. 21); the weight of cotton hose taken for analysis was 95·631 grms.

These hose for analysis were taken from a lot weighing 68 lb., and were fairly representative of an ordinary dye. It must, however, among other conditions, be remembered that the machinery and methods employed for rinsing and soaping hosiery are far more efficient than those used in ordinary experimental dyehouses. Such facts, which might be greatly amplified, justify me in saying that in dyeing hosiery with magentas, it is a difficult thing to fix arsenic upon the hose by an ordinary process of dyeing and finishing; indeed, it is rarely achieved.

Among the other "Aniline" colours used in hosiery dyeing, the absence of spirit-soluble blues and violets, and of those blues which are sulphonates of a substituted rosaniline base, are noteworthy. Various circumstances preclude the use of these colours in dyeing hosiery.

Of the blues, violets and greens which are in use, some are met with as double salts of the colour base and zinc. In order to know if zinc became fixed upon the dyed fabric, a Malachite green, a Methylene blue, and a Violet, all containing zinc, were dyed separately upon cotton hose mordanted with tannate of tin, then rinsed, dried, soaped, and redried. In no case was any zinc found to be fixed upon the fabric.

hosiery "anilines" are in contact with the skin in forms as insoluble as the dyer can make them.

From several analyses of the ash from various hose dyed with "basic anilines," those given in table below are selected as typical.

These gave an average of 55·4 per cent. SnO_2 , and of 69·4 per cent. Fe_2O_3 , upon the three on which iron has been used as a "saddener."

4. *Dyeing Woollen and Mixed Wool and Cotton Hosiery*.—The dyeing of these two fabrics may be conveniently considered together, since the wool of both is dyed, whereas the cotton absorbs and retains traces of some colouring matters during the process of wool dyeing. The dyeing is divided into two classes:—I. Those colours which need the mordanting to be a separate operation from the dyeing. II. Those colours which admit of dyestuff and mordant being applied simultaneously.

In Class I, the use of bichromate of potash is all-important. The mordanting is attained by boiling the fabrics for about 1 hour in a solution of bichromate of potash, with addition of tartar, of sulphuric acid, of alum, or of other metallic salts. The fabrics are then well rinsed with cold water by machinery, put through hydro-extractor, and are then ready for dyeing. The dyeing is attained by boiling the hosiery with various dyewoods, chiefly logwood, old fustic, eudbear, madder, etc.

WEIGHT OF HOSE.	COLOUR.	SnO_2	Fe_2O_3	Al_2O_3	REMARKS.
25·4312 grms.	Navy blue.	{ 1630 grm. = 641	{ 2370 grm. = 932%	Trace	{ Tannin, 6B violet and Malachite green, with little logwood, used as the dyes.
31·1738 grms.	Navy blue	{ 1861 grm. = 598%	{ 2693 grm. = 861%	Trace	
35·248 grms.	Peacock blue	{ 1945 grm. = 552%	None	None	{ Tannin with mixed 6B violet and Malachite.
47·621 grms.	Wine	{ 2466 grm. = 518%	None	None	
38·915 grms.	Dark Wine	{ 1280 grm. = 329%	{ 1116 grm. = 287%	None	{ Tannin with R violet and Magenta.
41·606 grms.	Cardinal	{ 2858 grm. = 686	None	None	

Before leaving the dyeing of cotton hosiery with "Aniline" colours, I would direct your attention to some of the facts brought before the Society of Dyers and Colourists (cf. *Journal* for November, 1884). (1) Mr. Ivan Levinstein says, "The German Government, after the most searching inquiries, permitted the use of all aniline dyes, with the exception of picric acid, for dyeing and colouring eatables and other purposes." (2) In the same *Journal* there are communications from twelve principal manufacturers of "anilines," and all agree that they have never heard complaints as to skin-irritating properties of "anilines" from the workmen whose hands and faces are continually covered with the dyes. (3) One gentleman, Mr. A. Nesbitt, states that he has "fed rabbits for many weeks on oats which had been steeped in strong solutions of magenta, violet, brown, orange, induline, chrysoidin, etc., without being able to find them any the worse for the treatment."

In these three references "anilines" in a soluble form are presented to the body, whilst in dyed

The variety of colours produced by this method is very great, ranging from black, dark blues, greens, browns, clarets to other lighter and brighter shades, all of which consist of an insoluble chromium lake, with rarely some trace of other metallic hydrates.

For our purpose to-night, Black—as represented by black cashmere stockings—is fairly typical of all these shades. It is the most heavily-chromed in mordanting, but otherwise is subjected to similar treatment as other shades. The use of bichromate of potash for mordanting wool and merino hosiery is very large, and in answer to a letter, asking when it first began to be used for *woollen hosiery*, Mr. Thomas Clark, of Loughborough, says: "I believe I began to use it about the year 1850." Since that time it has been increasingly used in mordanting woollen hosiery. The first table on next page gives five analyses of ash from black cashmere hose. These gave an average of 1·8088 per cent. Cr_2O_3 .

From the enormous quantities of wool and merino hosiery which have been dyed upon bichrome mordants during the past 35 years, it is difficult to

imagine any skin irritation charge being seriously made against goods so mordanted. It is well, however, to remember that the bichromate solution which penetrates and permeates the hosiery fabric becomes changed, possibly into insoluble chromic hydrate, during the dyeing operation, if not before; but in any case it is rendered insoluble.

Weight of Hose taken.	C ₂ O ₃ Found.	Remarks.
1. 41·225grms.	0·9346gm. = 2·267	The colours varied from the jet black to the rich blue black; also, sample 1 contained '051 Fe ₂ O ₃ ; sample 3 contained '083 Fe ₂ O ₃ .
2. 47·528grms.	0·8507gm. = 1·792	
3. 29·107grms.	0·4505gm. = 1·547	
4. 25·321grms.	0·4296gm. = 1·697	
5. 47·621grms.	0·8293gm. = 1·741	

In Class II., when the mordants and dyestuffs are applied simultaneously, we have animal, vegetable, and "azo" colours, and sulphonates of a colour base. Cochineal has, according to Mr. Thomas Clark, been used for dyeing scarlets, etc., upon woollen hosiery for "nearly sixty years." Tin mordants used for cochineal scarlets are very rarely employed for any other colour upon dyed hosiery. Indeed, for our purpose to-night, we may consider cochineal and tin mordants upon wool as things of a bye-gone era. The vegetable colouring matters are mainly old fustic, eudbear, madder, and "acid extract" of indigo and logwood.

The azo and sulphonated colouring matters most largely used are roccellin, Bordeaux R and G, orange 2, orange G, scarlets R and 3R, dark blues (*e.g.*, fast blues M.L.B.), whilst Naphthol Yellow S and Acid Magenta are also used to some extent. These colours all dye in an acid bath, usually along with alum, and are used for the production of scarlets, wine shades, dark greens, etc., as well as a variety of light bright tans and golds, drabs, slates, sages, etc. All these colouring matters, so far as they are used in hosiery dyeing, may be characterised as very inert, and not marked by any skin-irritating properties. MM. P. Cazeneuve and Lepine (*Compt. Rend.* 101, 1885) give results of very interesting experiments on men and animals by roccellin, which, in their opinion, is possessed of no toxic properties whatever; acid magenta is also non-poisonous; Naphthol Yellow S has not perceptible poisonous properties.

In all cases where dyestuff and mordant are applied simultaneously to hosiery, hydrate of alumina is deposited upon the wool and plays the part of a mordant. The following are analyses of ash from various woollen hose dyed in an acid bath, and which may be taken as typical of such colours:—

WEIGHT OF HOSE.	Colour.	Al ₂ O ₃ Found.	REMARKS.
33·589grms.	Wine colour	'0164gm. = '1382%	The navy blues are dyed with "extract" of indigo, and one of the various dark blues for wool. The scarlet and cardinal are dyed with "azo" scarlets, whilst the wine colours are dyed with "azo" reds, with slight admixture of "extract" of indigo.
80·901grms.	Navy blue	'1565gm. = '1935	
46·571grms.	Navy blue	'0573gm. = '1230	
76·312grms.	Scarlet	'1688gm. = '2213	
33·749grms.	Wine colour	'0326gm. = '0967	
32·561grms.	Cardinal	'0422gm. = '0129	

These give an average of 0·1309 per cent. Al₂O₃.

All colouring matters used in Class II. may fairly claim to have stood the test of time and wear, and all largely employed upon hosiery, but some, like extract

of indigo, have been very much longer employed than others.

5. "*Trimming.*"—When hosiery of whatever fibre has been dyed, washed, or even wet, it needs to be brought into shape and condition to be put upon the market. These ends are to a large extent obtained by "trimming." (1) The partly-dry hosiery which has been dyed with wrong side outwards is "turned," that is, the right side of the stockings, etc., are turned outwards by a boy inserting his arm in the stockings, etc. (2) These stockings, etc., are then pulled and dried upon a wooden board of the precise shape which it is desired to impart to them. (3) When dry the stockings, etc., are pulled off the board and straightened. These three operations are often conducted by two men and a boy, who are known as a "set." Two members of the "set" handle the stockings, etc., whilst damp and cold; the third handles them whilst hot and dry; and the hands of all three are coloured with the dye from the lot of goods at which they are at work. All hosiery is submitted to this process at least once, and frequently twice; after which it may be submitted to various other processes, all of which require each stocking, etc., to be handled separately.

After some inquiry I find there are about 250 to 300 people engaged in this work of trimming in and around Nottingham. These figures do not include those employed in and around Mansfield, Belper, Loughborough, Leicester, Hinckley. An average set of three will trim ten dozen pairs of stockings per hour; or taking one class of work with another, a set will trim 450 to 550 dozens per week on an average. It frequently happens that a "set" is at work upon goods mordanted with the same mordants and dyed with the same dyes for days together. But, on the other hand, these conditions may be changed several times a-day.

What, then, is the condition of the hands of these people employed in "trimming"? It is well to remember that in some respects our hands and feet are very similar. People have naturally moist or dry hands or feet. Dyed hosiery has to be handled, stocking by stocking, whilst damp and cold, as well as whilst hot and dry, by people the conditions of humidity of whose hands vary naturally. Owing to the friction applied by the hands to the dyed goods, the fingers and hands become covered with colour in pretty much the same way that the feet are coloured by wearing dyed cotton hosiery, etc. The friction causes a glazy appearance with a slight hardness of the skin when the man habitually has to strip the hot dry stockings off the board. But when the stockings are handled damp and cold, there is no sign of glaze and the hands are not hard.

If, then, dyes or mordants act as skin irritants, the

hands of these trimmers should be the first to show such irritation. Nothing, however, is further from the actual condition; such irritation is entirely unknown among trimmers. This conclusion is the

result of the observations and inquiries of myself and others extending over some years.

These considerations have an important bearing. The trimming of hosiery actually amounts to a very searching test of the skin-irritating properties of dyed hosiery *before it reaches the actual wearers*; or in other words, to a guarantee of the harmless character of the dye, etc.

6. *Wearing Hosiery.*—Probably the combined action of friction, heat, and moisture upon stockings or half-hose is greatest at the toe and the heel. To resist the greater wear and tear, all the better qualities are made stronger at toes and heels, and frequently over the whole foot sole, whilst wearers of dyed hosiery (specially cotton) will testify to their toes and heels being most coloured with the dye. From many observations I would say that *at the toe and heel* stockings are *acid* after a week's wear, whilst the intervening space on the hollow of the foot of the stockings do not indicate any appreciable change in their original slightly alkaline or neutral condition. This appears to indicate some action set up by increased friction between perspiration and the cotton fabric. It is of interest to state the fact now, although I hope at some future time to speak more fully about it when dealing with the solubility of the various metallic tannates and colour lakes in perspiration.

If it be granted, for the sake of argument, that the area of the sole of the foot represents the maximum area of a stocking which is subject to the severest friction and greatest combined action of friction with perspiration, then certain deductions will follow:—

We will take a plain (not "ribbed") stocking.

Now, an average woman's stocking presents an area in contact with the skin of 276 sq. ins. And a total *foot* area in contact with the skin of 59 sq. ins. Whilst the area of the sole of the foot which is in contact with the skin is..... 25 sq. ins.

(Double these figures are taken below in speaking of a pair of stockings.)

Thus, approximately, for no allowance is made for tightness or looseness of fit, and the fabric is elastic rather than rigid, the area of the sole of the foot is $\frac{1}{11}$ of the whole area of the stocking.

Taking 2½ lb. as an average weight for a dozen pairs of such stockings, a single pair will weigh 3oz. (= 1312½ grains), have a total area of 552 sq. in. in contact with the skin, and a total area over the soles of the feet of 50 sq. in. in contact with the skin.

Taking these figures, and turning to the analysis of ashes from various dyed hose, for the average percentage composition of the ash, we find—

Seal Brown Cotton.—Such a pair of stockings, with 552 sq. in. in area, weighing 1312½ grains, and with a percentage composition averaging CuO 1975 per cent., Cr_2O_3 1745 per cent., and Fe_2O_3 15400 per cent., would contain CuO 2592 grains, Cr_2O_3 2290 grains, Fe_2O_3 20212 grains, and therefore would only present $\frac{1}{11}$ of these quantities to the severest action of friction, heat, and perspiration; or 0.2356 grains CuO, 0.207 grains Cr_2O_3 , 1.837 grains Fe_2O_3 , which would be spread over 50 sq. in. in area.

*Wine Colours and Navy Blue Cotton.**—A similar pair with 552 sq. in. in area, weighing 1312½ grains, and with a percentage composition averaging SnO_2 554 per cent., Fe_2O_3 694 per cent., Al_2O_3 a trace, would contain SnO_2 7271 grains, Fe_2O_3 9108 grains, Al_2O_3 a trace, and therefore would only present $\frac{1}{11}$ of

these quantities to the severest action of friction, heat, and perspiration; or 0.661 grains SnO_2 , 0.828 grains Fe_2O_3 , a trace of Al_2O_3 , which would be spread over an area of 50 sq. in.

Black Cotton.—A similar pair with 552 sq. in. area, weighing 1312½ grains, and with a percentage composition averaging Fe_2O_3 1383 per cent., CuO 102 per cent., would contain Fe_2O_3 18151 grains, CuO 1338 grains, and therefore would only present $\frac{1}{11}$ of these quantities to the severest action of friction, heat, and perspiration; or 1.650 grains Fe_2O_3 , with perhaps 121 grain CuO, which would be spread over an area of 50 sq. in.

Turning from cotton to wool hosiery, and pursuing the same line of argument, it is well to remember that what applies to all-woollen hosiery applies also to mixed wool and cotton hosiery, but to a less degree—*e.g.*, all-wool stockings and a mixed wool and cotton one are dyed very frequently by one and the same method, the wool only being "dyed;" the cotton passing through the operation becomes "tinted" more or less permanently, but the cotton absorbs but very little of the mordant and dye which are upon the wool.

Again, taking the same figures for weight and areas of the stocking, and turning to the analyses of ash from wool hose for the average percentage composition, we find:—

Black Cashmere.—A pair with 552 square inches area, weighing 1312½ grs., and with percentage composition, averaging Cr_2O_3 18088 per cent. would contain Cr_2O_3 237405 grains; and, therefore, would only present $\frac{1}{11}$ of this quantity to the severest action of friction, heat and perspiration; or 21582 grains Cr_2O_3 spread over 50 square inches area. In thus selecting blacks we must remember that black represents the most heavily "chromed" colour; so that seal brown, dark clarets, myrtle green, some navy blue, and a host of lighter colours are comprehended, since the percentage of Cr_2O_3 includes the less.

Scarlets, Cardinals, Marones, some Navy Blues, Peacocks, and light and bright colours dyed with alum, etc., in an acid bath.—A pair with 552 square inch area, weighing 1312½ grains, and with a percentage composition averaging Al_2O_3 1309 per cent., would contain Al_2O_3 1718 grains; and, therefore, would present $\frac{1}{11}$ of this quantity to the severest action of friction, heat, and perspiration; or, 0.156 grains Al_2O_3 spread over 50 square inches area.

Very large deductions must be made from all these figures when we try to form any approximate idea of how much, if any at all, of the hydrated metallic oxides are absorbed by the skin. Washing in a hot alkaline liquid removes mechanically and chemically much of the hydrated oxides. When well worn out, the stockings still retain relatively large proportions of some of the hydrated metallic oxides.

It is very difficult to form any idea how long a pair of stockings is worn before being thrown aside, since it largely depends upon the activity and physique of the wearers as well as the quality of the colour. To see the best hosiery, both of manufacture and dye, well worn out with a marvellous amount of mending at the toes and heels, returned to the dyer with the naive question, "How is it the colour is gone?" is so common an experience, that it is highly probable the ordinary life of a good stocking frequently exceeds the tens of weeks in wear. In addition, I have more than once received from the wearers the information that "Their's never need mending the *first season*"; so that the actual time over which any skin absorption extends is great compared with the very small quantity of oxide present.

I must now conclude. I have endeavoured to put

* The methods of mordanting and dyeing justify bright reds, marones, clarets, navy blues, peacocks, and myrtle greens being all classed together here.

fairly before you several matters intimately connected with the dyeing and wearing of certain classes of hosiery. A brief consideration, say, of how long the wearing of dyed hosiery has been in vogue, of the large quantities annually produced, of the harmless character of the colouring matters employed, of the small quantities of metallic oxides or salts present in the colour lake, of the comparatively large area over which the colour lake is spread, of the amount of metallic oxide still remaining upon a well worn-out stocking, together with the "trimming" which hosiery undergo before being worn, will collectively furnish very strong evidence of the harmless character of fibres mordanted with iron, tin, aluminium, or chromium mordants, and dyed with the colouring matters usually employed in hosiery dyeing.

It remains for me to express my hearty thanks to my friend, Mr. H. Doidge, for much valuable assistance in the laboratory.

An Addendum to this paper, by Mr. H. Forth, together with the Discussion on both papers, will appear in the next number of the Journal.

A paper "On some Points in the Analysis of Oils, with Special Reference to Olive and Rape Oils," by L. Archbutt, notice of which arrived too late for insertion in the last number, and which was read on 9th April, will also shortly appear.

Bristol and South Wales Section.

Chairman : Prof. W. Ramsay.

Vice-Chairman : P. J. Worsley.

Committee :

R. W. Atkinson.
G. Dobson.
A. C. Fryer.
Thos. Morgans.
A. C. Pass.
F. Player.

W. Pringle.
Albert E. Reed.
G. S. Schacht.
W. A. Shenstone.
C. M. Thompson.
W. Windus.

Local Secretary and Treasurer :

E. G. Marks, St. Augustine's Chambers, Unity Street, Bristol.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held Thursday, March 18, 1886.

DENNIS B. HARRISON IN THE CHAIR.

A PAPER was read by W. RAMSAY, Ph.D., on the Nickel and Cobalt Ores of New Caledonia, and after a short discussion Dr. Ramsay read the following paper :—

ON THE PRODUCTS OF DECOMPOSITION OF CHLOROFORM AT A RED HEAT.

BY W. RAMSAY, MILD., AND SYDNEY YOUNG, D.S.C.

IN an investigation on dissociation in which we have been engaged, it has been our aim to discover bodies which dissociate within convenient limits of tem-

perature. Our attention was drawn to the existence of a substance named carbon monochloride, by Julin, by a perusal of Professor Carnelley's recent paper on the Periodic Law, *Phil. Mag.* 20, 506. It is there pointed out that the molecular weight of this substance must be much higher than that corresponding with the formula C_2Cl_2 ; and Berthelot (Watts' Dictionary, vol. i. 768) suggested the formula, $C_{10}Cl_{10}$ as probable, without having determined the vapour density of the body. In the *Journal of the Chemical Society*, 1867, p. 443, Mr. Henry Bassett investigated the subject, and professed to have established the identity of Julin's chloride of carbon with hexachlorobenzene, then recently discovered by Dr. Hugo Müller; the body obtained by him by passing chloroform vapour through a red-hot tube filled with broken porcelain gave numbers on analysis corresponding to the empirical formula, C_2Cl_2 , and he also determined its vapour density presumably by Dumas's method; finding 10.06 instead of 9.87, the theoretical vapour-density of $C_{10}Cl_{10}$ compared with air. There can be no doubt, therefore, that Mr. Bassett had obtained hexachlorobenzene. But the properties of the substance described in Watts' Dictionary, vol. i. p. 768, under the heading "Protochloride of Carbon," do not agree with those of hexachlorobenzene, inasmuch as the body is stated to melt, boil, and sublime between 175° and 200° ; whereas hexachlorobenzene melts at 231° , and boils above 300° . Both compounds, however, are described as crystallising in needles. The substance described in Watts' Dictionary is said to be very soluble in alcohol, while hexachlorobenzene is sparingly soluble. It is evident that these discrepancies are not explained by Bassett's results. The vapour of chloroform was passed through a combustion-tube, filled with asbestos, heated to dull redness by a long-flame burner. The product was distilled and the portion boiling below 85° was again passed through the tube; and this process was repeated until a sufficient quantity had been collected. The product was allowed to evaporate until crystals were deposited. These were separated by squeezing through cloth, dried, and sublimed by heating with aniline-vapour. On cooling the mother-liquor a fresh crop of crystals was obtained, which were treated in the same way. It soon became apparent that the solid consisted of two substances, one more volatile than the other; the more volatile was easily soluble in alcohol, the less volatile with difficulty. The less volatile substance was volatilised over a flame, and was deposited in needles. We found that crystallisation from acetone formed the best means of separation. On cooling a hot solution of both substances, containing a large proportion of the more volatile substance, plates of the latter were deposited in a nearly pure state; but after standing for some time long flexible needles of a pink colour made their appearance. It was necessary, therefore, to separate the plates soon after they were deposited. A second crystallisation from acetone gave the more volatile substance in a state of purity. The needles are almost insoluble in cold acetone, but being more soluble when hot their purification presented no difficulty.

These bodies proved to be hexachlorethane and hexachlorobenzene respectively, as shown by the following results :—

	C_2Cl_4 .	C_2Cl_4 .	C_2Cl_6 .	C_4Cl_6 .	C_6Cl_6 .	A.	B.	C.	D.
Cl, per cent	92.19	85.50	89.84	81.55	71.67	89.74	71.29	83.40	87.27
Vapour Density ..	76.80	82.74	118.41	130.2	142.11	—	129.0	86.5	120.0

perature. Our attention was drawn to the existence of a substance named carbon monochloride, by Julin, by a perusal of Professor Carnelley's recent paper on the Periodic Law, *Phil. Mag.* 20, 506. It is there

A. PLATES—

Analysis : 0.1765 grm. gave 0.6411 grm. AgCl, equal to 89.74 per cent. of chlorine. Calculated for C_2Cl_6 , 89.84 per cent.

The behaviour of the substance on heating was compared with that of a specimen of hexachlorethane, and was found to be identical.

B. NEEDLES—

Analysis: 0.2319grm. gave 0.6973grm. AgCl, equal to 74.29 per cent. of chlorine. Calculated for C_2Cl_4 , 74.67 per cent.

B. VAPOUR-DENSITY.—By Victor Meyer's method in vapour of boiling sulphur:—

Temperature of air, 12.5°.

Pressure, reduced to 0°, and corrected for vapour pressure of water, 75mmms.

Volume, 9.25ccs.

Weight of substance, 0.1088grm.

Vapour-density, 139.0 ($H=1$).

Calculated, 142.2.

The mother-liquor out of which these substances had deposited, and which amounted to only a few ccs., was fractionated as far as was possible. A portion boiling between 117.6° and 120.6° proved to be for the most part tetrachlorethylene, C_2Cl_4 .

C. ANALYSIS:—

i. 0.1805grm. gave 0.6065grm. of AgCl, equal to 83.01 per cent. chlorine.

ii. 0.1562grm. gave 0.5298grm. of AgCl, equal to 83.80 per cent. chlorine.

Calculated for C_2Cl_4 , 85.50 per cent. chlorine.

Vapour-density, by V. Meyer's method, at the temperature of boiling aniline ($t=184^\circ$).

i. Temperature of air, 11.3°.

Pressure reduced to 0°: and corrected for vapour-pressure of water, 729.5mmms.

Volume 11.0ccs.

Weight of substance, 0.0792grm.

Vapour-density, 87.21.

ii. Jacketed with bromonaphthalene vapour ($t=280^\circ$).

Temperature of air, 11.65°.

Pressure, corrected, 741mmms.

Volume 10.0ccs.

Weight of substance, 0.0718.

Vapour-density, 85.72.

Vapour-density calculated for C_2Cl_4 , 82.8.

Between the temperatures 175° and 200° the product was chiefly hexachlorethane, but below 175° a small quantity of some other body distilled, too small however to isolate.

D. A fair amount boiled between 210° and 220°, and although it was evidently impure, it was analysed, and its vapour-density was determined.

ANALYSIS:—

i. 0.1563grm. gave 0.5516grm. AgCl, equal to 87.19 per cent. of chlorine.

ii. 0.1202grm. gave 0.4250grm. AgCl, equal to 87.35 per cent. of chlorine.

Vapour-density, by V. Meyer's method, in vapour of bromonaphthalene (280°).

i. Temperature of air, 13.8°.

Pressure, reduced to 0°, and corrected for vapour-pressure of water, 739mmms.

Volume 7.75ccs.

Weight of substance, 0.0795grm.

Vapour-density ($H=1$), 120.9.

ii. Temperature of air, 16.2°.

Pressure, reduced and corrected, 746mmms.

Volume 9.1ccs.

Weight of substance, 0.0397grm.

Vapour-density, 118.8.

This body is evidently a mixture. The annexed table gives a summary of the percentage of chlorine contained in the known chlorides of carbon, and their vapour-densities; and it is evident that A is hexachlorethane; B, hexachlorobenzene; C, tetrachlorethylene; and D, a mixture possibly containing hexachlorethane.

Note.—From a subsequent conversation with Mr. Bassett, it appears that the temperature to which he heated the chloroform vapour was much higher than that to which we subjected it, thus accounting for the much larger yield of hexachlorobenzene which he obtained.

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Improvements in Filter-presses. R. J. Friswell and A. Myall, London. Eng. Pat. 3055, March 9, 1885. 8d.

THE patentees state that in filter-presses of ordinary construction, in which the filtering chambers are formed by recessed plates having corrugated drainage surfaces, the operation is retarded by reason of the cloths being forced into the grooves, and the flow of liquid in them thereby stopped. This they state can be obviated by covering the grooved surfaces with woven wire-work, or an incompressible woven material secured round the central orifice by a thin metallic ferrule and sprung into a groove or recess in the periphery of the chambers. The cloths are placed over this in the ordinary manner. Seven claims cover this and the mode of carrying it into effect.—C. C. H.

An Improvement in Fusible Plugs. William Henry Bailey, Salford. Eng. Pat. 3637, March 21, 1885. 6d.

A SHORT length of open tube is screwed into the boiler plate, and on to the end projecting into the water space is fastened, by means of a screw cap, a fusible metal plate covered with a second disc of copper or brass, which will be forced out by the pressure of steam when the fusible plate melts; the water thus never comes into contact with the fusible metal, and chemical action is therefore avoided.—W. G. M.

Improvements in the Method of and Apparatus for Purifying the Feed-water for Steam Boilers. H. E. Newton, London. From A. L. G. Dehne, Halle-on-Saal. Eng. Pat. 5149, April 25, 1885. 8d.

THE feed-water is first passed through a heater, next into a closed vessel, in which it is mixed with one or more reagents, depending upon the impurities to be removed. From this vessel it passes into a filter-press, from the closed continuous outlet channel of which it is drawn by a pump; the delivery pipe from the pump passes it into a third vessel, where it comes in contact with iron turnings or coke for the purpose of removing "any earthy matters that may still be retained;" from thence it passes into the boiler. The reagents are pumped into the closed vessel by a small pump which bears a fixed proportion to the pump dealing with the whole of the water; both being driven simultaneously, the proper proportion of reagent is always delivered, notwithstanding any variation in the speed of pumping.—C. C. H.

Method of and Apparatus for Treating Semi-liquid Substances with Purifying or other Liquids. E. Langen, Cologne. Eng. Pat. 4473, April 10, 1885. 8d.

THE apparatus consists of a perforated hollow cylinder A, revolving on bearings, and running in a trough B, between scrapers C. The pump D communicates with the trough B by means of its suction pipe, and its

* Any of these specifications may be obtained by post, by remitting the cost price, plus postage, to Mr. H. Reader Luck, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8d.....	4d.
Above 8d., and not exceeding 1s. 6d....	1d.
" 1s. 6d., " " " 2s. 4d....	1d.
" 2s. 4d., " " " 3s. 4d....	2d.

delivery pipe communicates with supply trough F. When a semi-fluid crystalline mass, such as sugar, suspended in a liquid is passed over the cylinders, the liquid used for washing in the end cylinder of the series is withdrawn by the pump D, and supplied to the next cylinder from the trough F; from the second

which large volumes of dust-laden air are passing, the impurities being left behind. Vertical cloth bags are secured with their lower open ends to the tops of boxes which receive the dust-laden air in front of an inclined internal partition, behind which the deposited dust is collected, and is removed by the action of a screw ear-

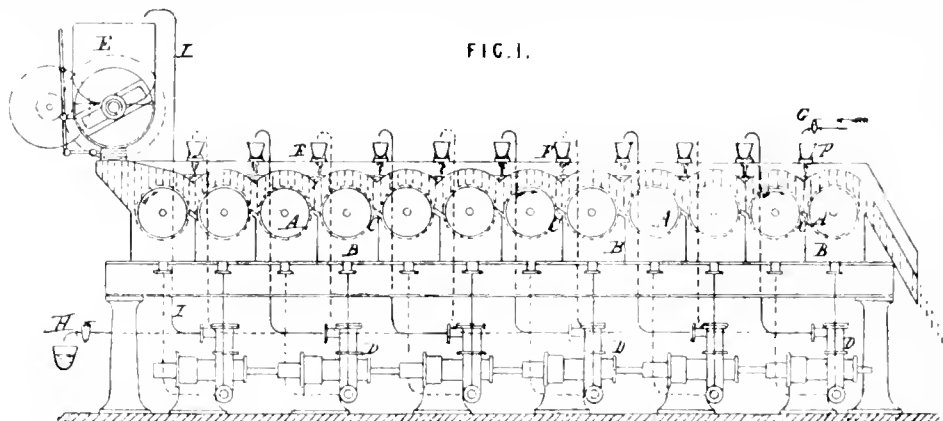


FIG. 1.

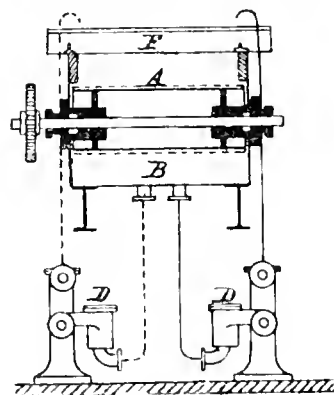


FIG. 2.

cylinder it is again withdrawn by another pump and passed on to another cylinder, and so on through the series. The patentee claims this method of washing or treating substances, and also the combination of apparatus described and shown.—C. C. H.

Improvements in Metallic Thermometers with Dials. W. H. Gauntlett, Middlesbrough-on-Tees. Eng. Pat. 5671, May 8, 1885. *Sd.*

THE inventor makes use of the difference of expansion of two strips of dissimilar metals soldered together and bent in the shape of an open ring, giving motion in opposite directions to the ends of the ring, which carry between them the spindle of the indicator-hand. The ends are fashioned to overlap each other in the plane of the ring, and in a manner parallel to their own motion. The spindle being held between them and touching them both, is caused to turn round by their opposite motions, without at the same time in any way changing the position of its axis, which remains steady as if held in bearings. The latter are therefore dispensed with. The parallel end bars of the ring are by preference provided with fine teeth, the spindle being cut to match, so that the movement of the latter is a positive one.—B.

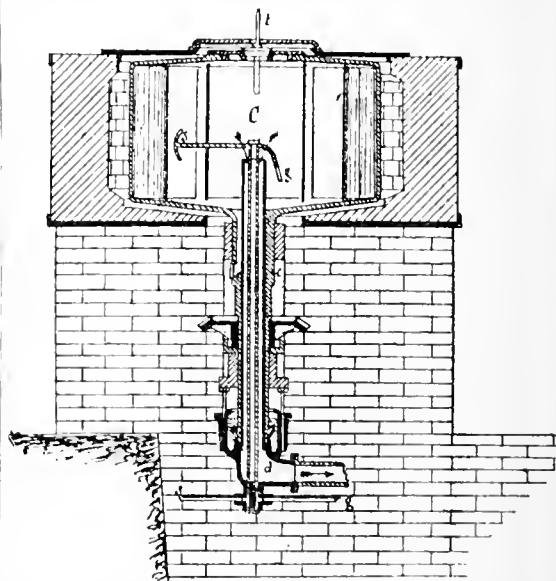
Improvements in Apparatus for Separating Dust from Air. H. H. Lake. From Ch. H. Morgan, Buffalo. Eng. Pat. 15,779, December 22, 1885. *Sd.*

THIS invention relates to apparatus for separating and collecting the dust deposited on filter-bags through

rier. The upper closed ends of the filtering bags are suspended from pulleys and shafts, which cause their periodical alternate rise and fall, simultaneously with a slight shaking, the result being a loosening and dropping of the deposited dust. At the time of the dust falling, the supply of air through the filters is arrested through the self-acting closing of the inlet valves provided in the partition, whilst other valves open to admit the dust to the creepers, the action of the valves being reversed, when the bags are in position again for the next charge of air.—B.

Distilling Apparatus. H. J. Haddan, Strand. From A. Liedbeck, Stockholm. Eng. Pat. 5654, May 7, 1885. *Sd.*

IN this invention a distilling vessel is used of cylindrical shape with vertical axis. To the centre underneath the vessel is fixed a hollow shaft, to which suitable quick rotary motion can be given. Up the centre of the shaft



passes a hollow tube, through which the liquid to be distilled is conveyed to the vessel, whilst the vapours of distillation pass down through the annular space left

between the shaft and the tube, and are carried away by a radial pipe connected to the lower part of the shaft by means of a conical metallic revolving joint. The vessel may be exposed to heat in any convenient manner, and distillation may be carried on in vacuo or under air pressure, whilst the axis of the apparatus may be inclined instead of vertical. The accompanying figure shows a section of the apparatus, and indicates the principle of construction.—B.

Improvements in Apparatus for Measuring Equal Quantities of Fluids. J. H. Wüster, Ybbs, Austria. Eng. Pat. 72, January 2, 1886. 8d.

THIS is a contrivance for delivering equal volumes of fluids out of a containing vessel upon successive openings

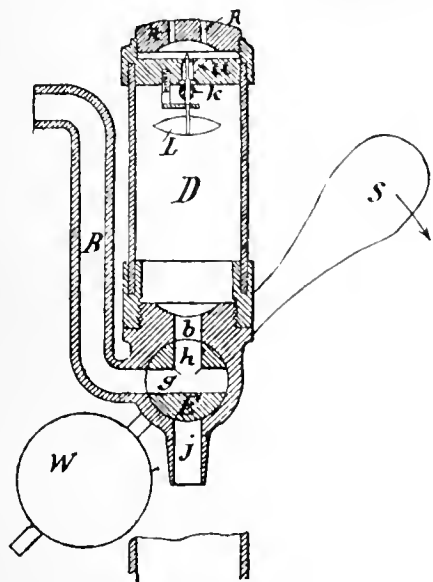


FIG. 1.

and closings of a tap. The plug of the tap is hollow, and of sufficient capacity for holding the largest quantity of the liquid that may be required to be measured out. It

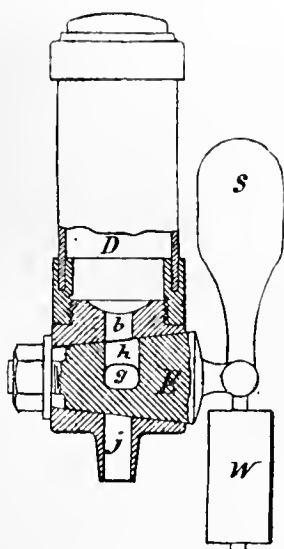


FIG. 2.

has two openings, communicating respectively with the supply and discharge pipes, but placed so that communication cannot take place with both pipes simul-

taneously. A float within the tap regulates and measures the liquid admitted when the interior is in connection with the supply, and on the tap being partly turned round, the liquid is discharged. The measuring receptacle may be a separate vessel with a two-way tap fitted underneath, and the latter may be made either to turn or to slide. The two figures show the latter arrangements, the first with a turning tap underneath, the second with the sliding tap. In both, B is the supply pipe, J the discharge, and D the measuring vessel.—B.

Improved Method for the Manufacture of Anhydrous Ammonia and for the Utilisation thereof for the Production of Cold or Work or of both Cold and Work together. A. Osenbrück, Bremen. Eng. Pat. 719, January 16, 1886. 8d.

GLYCERINE is proposed as a substitute for water for absorbing ammonia in ammonia gas-engines. The boiling temperature of glycerine being much higher than that of water, the separation of ammonia from a glycerine solution can be effected at a temperature where even an aqueous glycerine solution gives off a perfectly anhydrous ammonia, which after being condensed, on evaporating will considerably increase the useful effect of the engine. The use of ammonia as a motive power can be effected in two different ways. Firstly by driving off the ammonia from the glycerine solution, and then condensing the same, such liquid being then evaporated for the purpose of producing cold. It is then caused to act in the cylinder of a motor engine so as to produce an amount of work corresponding to its pressure and quantity, and lastly it is again absorbed. Or the elastic pressure of the ammonia vapour separated from the glycerine solution in the distilling apparatus is directly applied in the cylinder of a motor engine for the production of work, after which the vapour is again absorbed. The author describes the details of an apparatus based on the latter mode of operating.—S. H.

II.—FUEL, GAS, AND LIGHT.

Improvements in Distilling and Obtaining Useful Products from Coal or other Carbonaceous Mineral, and in Apparatus therefor. F. J. Rowan, Glasgow. Eng. Pat. 2693, February 28, 1885. 11d.

IT is proposed to combine in one continuously-working arrangement of apparatus, a distilling chamber or retort, and a chamber for converting the coke or fixed carbon with the aid of steam, but without the introduction of air. Both portions of the apparatus are heated externally, a high temperature being applied for the final conversion of the coke, in order to minimise, and, if possible, prevent the formation of carbonic anhydride in the water-gas resulting from the decomposition of the steam introduced. The coal passes continuously, first into and through the distilling chamber, and subsequently into the second, or coke-converting chamber, without being withdrawn from the apparatus or cooled. The ash which collects at the exit end of the second chamber may be removed either periodically or continuously by any suitable appliance. This apparatus may be adapted with advantage to gas-works retorts. A special feature is said to consist in the reduced volume and increased richness of the gas, due to the absence of nitrogen, which greatly facilitates its treatment by condensers and scrubbers for the purpose of separating condensable hydrocarbons and ammonia.—D. B.

Improvements in or incidental to the Separation of Ammoniacal Products and Tar from Producer or other Furnace Gases. L. Mond, Chester. Eng. Pat. 8973, July 25, 1885. 6d.

THE condensation of tar and ammoniacal products from producer or furnace gases is usually effected by passing the gases through iron pipes exposed to the air or cooled by water. This operation being very tedious and in-

volving the exposure of large surfaces, the following method has been devised. The gases are passed through a scrubber, in which they are cooled to 40° by a current of water flowing in a direction opposite to the current of gas. The water issuing from this scrubber, and containing ammonia and tarry products, is cooled, an apparatus being employed in which the hot water flows in one direction and the cold water in the opposite direction. The water, after being cooled in this manner, is again passed through the scrubber, and then through the cooling apparatus, and so on, the same water being constantly used. The steam in the producer gases being condensed by this treatment, a quantity of water equivalent to the condensed steam is drawn off at intervals, and from it the ammonia is recovered. To obtain the latter in the form of sulphate direct, the gases issuing from the producer are passed into scrubbers, through which a very dilute solution of sulphuric acid (2 of acid to 100 of water) flows. The solution of ammonium sulphate thus obtained is used repeatedly, sulphuric acid being added after each absorption, in order to bring the solution to the original acidity. This operation is continued until a concentrated solution is obtained, from which the salt is separated by crystallisation and evaporation. The tar which accumulates in the water used in the scrubbers is separated and removed from time to time, whilst the gases, after leaving the cooler, are burned. A saving of all, or the greater part of the fuel now used for raising steam for the purpose of working gas producers, under patents Nos. 3821 and 3923 of 1883, is said to be effected by this method. See also this Journal, 1883, 233 and 236.—D. B.

An Improved Process of Extracting from Carboniferous Materials the Products met with in the Process of converting into Gases, and of withdrawing Gases. H. Stier, Zwickau, Saxony. Eng. Pat. 12,298, October 15, 1885. 8d.

This process is based on the fact that the distilled products from carbonaceous materials of little value contain a somewhat larger quantity of carbon than is necessary for their conversion into gas. It depends also on an arrangement, by means of which, in utilising the preceding fact, the processes of gasification and distillation assist one another. The inventor claims: "A method for obtaining the products of abstraction of gas (distillation), of gasification (heating gas), or for obtaining distilled products, according to which method, alternately in one chamber of each pair of the chambers, the gasification takes place, and in the other chamber the abstraction of gas (distillation) in such a manner that the last operation is always effected by the first operation."—D. B.

Improvements in the Manufacture of Briquettes or Fuel Blocks. W. Black, Stanrigg, Airdrie. Eng. Pat. 3790, December 22, 1885. 6d.

PULVERISED coal dross, peat, or similar carbonaceous material is compressed into blocks with shale-oil pitch. When the blocks are to be used in lieu of gas-coal for the production of illuminating gas, the hydrocarbon products left in the distillation of mineral oils may advantageously be substituted for the shale-oil pitch.

—A. R. D.

An Improved Process of Treating Coal Dross and other Carbonaceous Substances. W. Black, Stanrigg, Airdrie. Eng. Pat. 4414, January 5, 1886. 4d.

THE carbonaceous matter is heated in a closed vessel under reduced pressure, whereby it is freed from moisture and any air or gas that it may contain. While still under reduced pressure, it is impregnated with pitch or oil, such as the residual products of the distillation of mineral oils. The resulting mass may be used in its amorphous condition, or formed into briquettes by suitable machinery. It is available for fuel or for the production of illuminating gas.—A. R. D.

Improvements in Apparatus for Enriching Illuminating Gas. Jas. Parkes, Aston, Warwickshire. Eng. Pat. 454, January 11, 1886. 6d.

THE carburetter is a vessel placed so as to receive heat from one of the burners, and has an inlet pipe (cast in one piece with it) so disposed as to cause the entering gas to impinge upon the surface of the heated hydrocarbon in the vessel. The outlet pipe passes down obliquely through the interior of the carburetter, the heat of which prevents its clogging up.—A. R. D.

Apparatus for Combustion of Liquid Hydrocarbons. Percy Tarbutt, London. Eng. Pat. 5599, February 4, 1886. 8d.

WITHIN the firebox of the furnace or boiler to which this invention is applied, a combustion chamber of refractory material is placed, with openings for the issue of the flame and products of combustion. Into this combustion chamber liquid hydrocarbons are injected by means of a jet of steam which has been superheated by passing through a coil of pipe situated in the lower part of the combustion chamber. The air required is admitted round about the injector. Water enters the superheating coil from a pressure tank supplied by a pump.—A. R. D.

III.—DESTRUCTIVE DISTILLATION. TAR PRODUCTS, Etc.

The Transformation of Pyrroline into Pyridine. M. Dennstedt and J. Zimmermann. Ber. 18, 3316—3318.

SOME time ago it was shown that by the action of chloroform and bromoform on potassium pyrroline, chloro- and bromopyridine respectively are formed. The latter is reduced, bromine being eliminated and pyridine and hydropyridine formed. The presence of pyridine in the reduced compound was shown by Ciamicián and Silber, who also found that chlor- and bromoform act similarly upon pyrroline in presence of potassium and sodium alcoholate. With methylene chloride, on the other hand, no reaction occurs. When methylene iodide, pyrroline, and sodium methylate are heated in sealed tubes to 200°, pyridine is formed, which fact was confirmed by the analysis of the platinum salt. The yield was, however, exceedingly small, so small that the reaction cannot throw any fresh light upon the formulae of Baeyer and Schiff.—J. B. C.

α - and γ -Picolines. O. Lange. Ber. 18, 3436—3441.

THE author has separated α -picoline from animal oil by means of its sparingly-soluble mercuriochloride, having found that the process adopted by Weidel, and involving fractional crystallisation of the α - and γ -picoline platinochlorides, is less practical. The mercuriochloride of α -picoline is obtained in a microcrystalline and almost pure form from the fractions boiling at 128—130°, 130—133°, and 133—136°. It is sparingly soluble in cold, readily soluble in hot water, and melts at 154—155°. The pure base, obtained by decomposing the mercuriochloride with caustic potash and distilling with steam, was found to boil at 129—130° (and not 133·9° as given by Weidel, Ber. 14, 2008). Its specific gravity at 0°, compared with water at 4°, is 0·96559 (Weidel, 0·96161). The platinochloride forms small crystals melting at 178°; the aurochloride and the picrate crystallise in needles, melting at 167—168° and 165° respectively. Both these last-named salts are readily soluble in water. γ -picoline is most conveniently prepared by employing Ladenburg's synthetic method with pyridine and methyl iodide. On distilling the product obtained from pyridinemethiodide, two principal fractions are yielded, which boil at 127—134° and 145—150° respectively. The former contains α -picoline, whilst the latter consists mainly of γ -picoline. This base, when pure, boils at 144—145°, and has a specific gravity of 0·9708 at 0°, compared with water at 4°. On oxidation, isonicotinic acid is obtained—a

reaction which proves that the methyl group of this picoline is in the γ -position to the nitrogen. The salts of the base are more or less sparingly soluble in water. The platinumchloride melts at 225° – 226° , the anrochloride forms fine laminae melting at 205° , the mercuriochloride long white needles melting at 136° – 138° , and the picrate silky needles melting at 156° – 157° .—D. B.

Note on Metacresol. W. Staedel. Ber. 18, 3443–3444.

METACRESOL is generally described as a liquid which does not solidify even at -80° . The author, however, shows that when prepared in a pure form from metatoluidine obtained from metanitrobenzaldehyde, according to Widmann's method, it can be made to crystallise when cooled in a freezing mixture of ice and salt to -18° by the addition of minute crystals of phenol, which it resembles in crystalline form. Metacresol solidified in this manner, melts at 3° – 4° . Similar trials were made with commercial metacresol, but the results were less satisfactory. In a freezing mixture composed of ether and solid carbonic anhydride, a glass-like mass was obtained. The author is continuing his experiments in this direction.—D. B.

On 1:3:4 Metaxyleneol. O. Jacobsen. Ber. 18, 3463–3464.

IN a recent paper by Staedel and Hölz (Ber. 18, 2919), 1:3:4 metaxyleneol has been described as a solid crystalline substance, melting at 27° – 28° . The author, on investigation, found that although this xylenol can be obtained in a crystalline form, its melting-point is lower than that given by Staedel and Holz. He obtained numbers varying between 25° – 4° and 26° . The true boiling point is 211° – 5° , Staedel's number 216° – 5° being due to an error in his thermometer.—D. B.

Improvements in obtaining Ammonia in connection with the Distillation of Oil-yielding and Carbonaceous Minerals. A. Neilson and J. Snodgrass, Inkermann, N.B. Eng. Pat. 4902, April 21, 1885. Sd.

THIS invention, which is applicable to horizontal as well as to vertical or inclined retorts, is carried out in the following manner:—Each retort is worked with separate complete charges, and after having worked off the whole or larger quantity of the oil in the ordinary way, air and steam, previously mixed, are introduced into the retort, all external heating being discontinued. The introduction of air in this way causes the combustion of the carbonaceous matter remaining in the retort, and the production of increased heat, the result of the action being the evolution of a large amount of ammonia in addition to that obtained in the primary distillation. —D. B.

IV.—COLOURING MATTERS AND DYES.

Experiments in the Preparation of Aniline Black. Chem. Zeit. 9, 1671.

FOUR experiments were made with the following quantities, in which aniline hydrochloride was decomposed with KClO_3 and HCl , and a small quantity of CuCl_2 then added:—

CuCl_2 .	Aniline hydrochl.	Chlorate.	HCl (15 per cent.)
2	1grm.	5grm.	5cc. bad yield.
2	1 "	10 "	10 " good "
2	1 "	20 "	20 " super oxidised.
2	1 "	30 "	30 " "

By oxidation in neutral solution a bad yield was obtained. In experiment 2, from 1grm. aniline salt, 51grm. aniline black was obtained—that is, 70 per cent. of the aniline used. On a larger scale 100grms. aniline salt were dissolved in 250grms. water, 5grms. CuCl_2 added, to this 100cc. strong hydrochloric, and then a hot solution of 100grms. KClO_3 . The action occurred with almost explosive violence, and with evolution of chlorine, the mass becoming solid. The yield of aniline black was

90grms. Of this aniline black, 20grms. were heated with 40grms. aniline for $\frac{1}{2}$ hours to 180° , the excess of aniline being then removed with hydrochloric acid. A black substance remained behind, soluble in alcohol, possessing, on drying, a metallic lustre. The above method for the preparation of aniline black is similar to that of Suida and Liechti, whose experiments were commenced at a later period. The opinion of these chemists—viz., that aniline black is formed essentially from aniline chlorate—is in accordance with the result of the authors' second experiment. In order to transform aniline salt into aniline chlorate, equal molecules of both compounds are necessary, and these correspond to equal parts by weight.—J. B. C.

A By-product in Commercial Phenyl-hydrazine. E. von Meyer. J. Prakt. Chem. 1885, 32, 430.

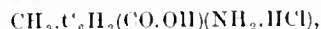
PEITZINGER has observed that upon mixing phenylhydrazine with benzene, a crystalline body separates on shaking. The substance contains sulphur, and forms small saponaceous foliated crystals, insoluble in water and benzene, and melting at 96° . The compound is very unstable, decomposes in the air, and cannot be purified by recrystallisation. Its solution in acetone leaves, on evaporation, a dark oil smelling strongly of phenylmercaptan. The substance dissolves in caustic soda, with a reddish colour. HCl precipitates from this solution a dull green compound. On heating with HCl in a closed tube to 230° , sulphur is split off as CS_2 . —J. B. C.

Para-methylisatoic Acid and other Derivatives of Para-methylisatin. W. Zanaotovic. J. Prakt. Chem. 33, 57–75.

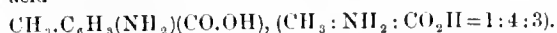
THE object of the author is to show the relationship of p -methylisatin to isatin by a comparison of their chemical behaviour. This has been fully demonstrated by the following experiments. The p -methylisatin, which served as a basis for this investigation, was prepared from p -tolyl- p -methyloxysatin by the action of dichloroacetic acid upon p -toluidine. Like isatin, p -methylisatin is oxidised by chromic acid in glacial acetic solution to p -methylisatoic, or anthranilcarboxylic acid—



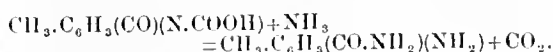
This acid differs from isatoic acid in being very much more stable in presence of dilute mineral acids. Strong nitric acid forms a nitro-compound. With strong HCl it gives the hydrochloride of methylantranilic acid—



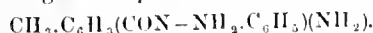
from which the free acid is readily obtained as a crystalline mass, identical with Jacobsen's α -amido- m -tolnic acid—



With nitrous acid it is converted into the corresponding oxyacid or p -methylsalicylic acid. By the action of aqueous ammonia upon p -methylisatoic acid, p -methyl-anthranilamide is formed with evolution of CO_2 .



aniline acts similarly, and also phenylhydrazine, the latter forming the compound—



Methyl alcohol heated with p -methylisatoic acid to 180° gives p -methylantranilic-methyl-ether. Attempts to oxidise the methyl group of the acid gave unsatisfactory results. p -Methylisatin gives, with acetic anhydride, an acetic derivative, in which the acetyl group, as in isatin, is attached to the N atom. This compound gives amides with NH_3 . p -Methylisatin forms with phenylhydrazine, a compound having the formula—



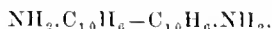
—J. B. C.

Liebermann's Phenol Colouring Matter. T. Lehmann and J. Petri. Arch. Pharm. (3), 23, 243—248.

NITROSYL-SULPHONIC ACID gives, with phenol, two substances, one of which is Liebermann's colouring matter, and has already been the subject of investigation. This colouring matter gives a characteristic nitro-compound, with fuming HNO_3 , forming a dark green powder, soluble in alcohol and ether, with a green colour similar to chlorophyll, which it also resembles by its peculiar fluorescence. If the colouring matter, whilst still moist, from H_2SO_4 used in its preparation, be heated to 100° , it undergoes a change as shown by the spectroscopic, and then possesses a colour similar to that of litmus, and may be employed as a substitute for the latter in volumetric analysis. The preparation of this compound resembles that of the previous one; 5cc. phenol are mixed with 5cc. conc. H_2SO_4 , the mixture being cooled. To this 20cc. nitrosyl-sulphonic acid are added drop by drop. The solution is then heated to and kept at 80° until the melt has become dark violet, and a sample mixed with H_2SO_4 until transparent, does not give the characteristic spectrum for Liebermann's colour. The mixture is then poured into cold water, whereupon the new substance separates out as a dark violet amorphous powder. After washing and drying at 100° , it may be dissolved in ether, and used as an indicator.—J. B. C.

Azonaphthalene and its Derivatives. R. Nietzki and O. Goll. Ber. 18, 3252—3260.

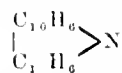
THE authors previously prepared a compound, to which they gave the name of α -azonaphthalene (this Journal, 1885, 276). They now endeavour to determine its constitution. The preparation of the compound has been simplified. 1 part amidoazonaphthalene is dissolved in 100 parts of 95 per cent. alcohol, 5 parts concentrated H_2SO_4 added, and NaNO_2 dissolved in the least quantity of water poured into the warm liquid. The violet colour of the liquid changes to a red-dish yellow. The liquid is boiled for some hours, and the product precipitated with water. This crude product is subsequently dissolved in hot aniline, and alcohol added to the solution, when blue crystals of azonaphthalene separate after cooling. The constitution of azonaphthalene may be determined with a comparative degree of certainty from its formation. α -Naphthylamine condenses with diazo-compounds, and the azo-group takes up the second α -position to the amido-group of the same benzene nucleus. Amidoazonaphthalene splits upon reduction into α -naphthylamine and α — α naphthylene diamine, the latter giving naphthoquinone. The formula will, therefore, be $\text{C}_{10}\text{H}_7\text{N}=\text{N}\cdot\text{C}_{10}\text{H}_7(\text{N}:\text{N}=\alpha:\alpha)$. The compound behaves like the azo-compounds of the benzene series. With reducing agents it gives hydrazo-naphthalene, from which two isomeric diamidodiphenyls are formed. With alcoholic ammonium sulphide the azo- and hydrazo-compounds give α -naphthylamine. With zinc dust in alcoholic soda solution, azonaphthalene gives hydrazonaphthalene, a colourless substance crystallising in scales which melt at 275° . It is insoluble in water, soluble in alcohol, ether and benzene. As in the case of hydrazobenzene, hydrazonaphthalene, when treated with mineral acids, gives two isomeric diamidodiphenyls. If hydrazonaphthalene be heated with dilute HCl , it dissolves, and on addition of conc. HCl , "Naphthidine" hydrochloride separates out. Alkalis liberate the free base, which crystallises like benzidine in scales melting at 198° , and has the formula—



It forms crystalline salts with two equivalents of acid, and a diacetyl-derivative with acetic anhydride. Oxidising agents like Fe_2Cl_6 , CrO_3 , or Cl give, with solutions of naphthidine salts, a beautiful carmine coloration. With nitrous acid it yields a diazo-compound which combines with the sulphonic acids of β -naphthol with the formation of violet azo-colouring matters. The phenol could not be obtained pure; but by the action of alcohol the hydrocarbon dinaphthyl was obtained, identical with Lossen's α - α -dinaphthyl. The second and soluble hydrochloride

obtained by the action of HCl on hydrazonaphthalene, has, from its similarity to diphenylamine, been named "dinaphthylamine." It has the peculiar property of being decomposed by boiling with acids (even with acetic and picric acids), into ammonia and dinaphthylimide. When oxidised, it yielded phthalic acid, but no naphthoquinone. Its diazo-derivative yields the same dinaphthyl as dinaphthidine. The difference between these two bodies must, therefore, be due to different positions of the amido group, which the author discusses in detail.

The above-mentioned dinaphthylimide is formed if dinaphthylamine be heated with strong HCl to boiling, and separates out as an insoluble colourless crystalline substance. The filtrate contains NH_4Cl . This compound has the formula $\text{C}_{20}\text{H}_{13}\text{N}$, and is formed according to the equation:— $\text{C}_{20}\text{H}_{16}\text{N}_2=\text{C}_{20}\text{H}_{13}\text{N}+\text{NH}_3$. The stability of the one N atom makes it appear that the substance is dinaphthylcarbazon—



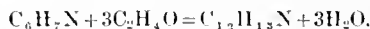
and the various reactions given confirm this view. It crystallises in colourless needles or scales melting at 216° , and soluble in alcohol, benzene and glacial acetic acid. It yields nitroso- and acetyl-derivatives.—J. B. C.

Action of Acetone upon Aniline. C. Engler and P. Riehm. Ber. 18, 3296—3297.

A REPLY to C. Beyer, who found that by the action of aniline on acetone, no α - γ -dimethylquinoline is formed. The authors have repeated their experiments with the former results (this Journal, 1885, 740).—J. B. C.

By-products of Quinaldine. O. Doebner and W. v. Miller. Ber. 18, 3352—3353.

EINHORN having recently described an aldehyde of the quinoline series, the authors considered it desirable to make some observations in continuation of their researches on quinaldine derivatives. Having treated crude quinaldine with nitrous acid, as formerly described, in order to remove aniline, monethyl-aniline, and tetrahydroxy-quinaldine, the purified substance was subjected to fractional distillation. In addition to quinaldine boiling at 240° , higher boiling fractions were invariably obtained. The platinum salt prepared from the portion of the distillate coming over between 270° and 280° , gave numbers corresponding to the formula for trimethylquinoline $\text{C}_{12}\text{H}_{13}\text{N}$, formed probably by the action of 3 molecules of aldehyde on aniline, thus—



On oxidation with chromic acid the base yields an acid insoluble in water, the investigation of which is still in progress. The question whether this base is related to the aldehyde discovered by Einhorn is not solved by the authors.—D. B.

Ultramarine by the Wet Method. F. Knapp. J. Prakt. Chem. 1885, 32, 375.

THE author shows that ultramarine blue can be prepared in the wet way, similar to that obtained by the usual method. Silicate of alumina is heated with carbonate of soda and sulphur to a certain temperature, and the product digested with a solution of sodium persulphides. The blue obtained in this way does not compare unfavourably with that obtained by the old method. The principal precaution required in the operation is to roast the mixture, when the kaolin is decomposed. The limit between this temperature and that at which the blue is destroyed makes the success of the operation a difficult one. In course of roasting, the colour of the mixture becomes a darker yellow, then a cinnamon brown, and then a red. The brown colour indicates the correct temperature. The presence of sulphide of iron has an injurious effect. Kaolin is scarcely ever free from iron; and sulphur is also contaminated with it.

—J. B. C.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

A New or Improved Method of applying Waterproofing Material to Pile and other Goods. Bertie Hallett and Thomas Fernely Wiley. Eng. Pat. 5512, May 5, 1885. 6d.

SUCH goods as cannot be conveniently rendered waterproof by the ordinary methods, are treated by the inventors in the following way: A series of jets is so arranged that a blast of air passing through them carries with it a quantity of the waterproofing material, which is deposited on the article in the form of a very fine spray.

—E. J. B.

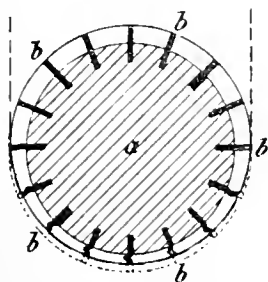
Improvements in Apparatus for treating Fibres, Yarns, and Textile Fabrics. C. D. Abel. From Julius Otto Obermaier. Eng. Pat. 6593, May 30, 1885. 8d.

THE present invention relates to a method and apparatus patented by Obermaier in 1883, 2181. The dyeing vessel there described is in the present instance arranged so as to fit on to the shaft of a centrifugal machine. In this way nearly the whole of the superfluous solution can be readily removed, and a fresh one substituted without necessitating the removal of the material. The specification is accompanied by drawings.—E. J. B.

Improved Apparatus to be employed in Washing, Soap-ing, Dyeing, and Darning Woven Fabrics. William Birch. Eng. Pat. 1424, February 1, 1886. 6d.

THIS invention relates to an improvement in the construction of the rollers over which cloth is passed when it is desired to impregnate it with various solutions. A series of longitudinal grooves is cut in the rollers, and

FIG 1



filled with strips of indiarubber (Figs. 1 and 2). The strips are connected by short pieces placed at right angles, thus forming a series of rectangular compartments. The tension of the cloth passing over the rollers compresses the rubber strips, and forces the solution, which has been taken up by the compartments, into the cloth, which is in this way thoroughly impregnated.—C. F. C.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

The Influence of Artificial Bleaching in Turkey-red Dyeing. P. Lukinoff. Dingl. Polyt. J. 259, 97.

THE author's experiments showed that the Turkey-red on cloth which had been bleached by oxidising agents (bleaching powder solution) was, although very pure, not so full in colour as on unbleached cloth. He thinks this may be ascribed to the formation of Witz's oxycellulose, and Cross and Bevan's basic oxycellulose; and whereas the former serves as a mordant for aluminium hydrate, it acts at the same time like a colloidal substance, preventing the fixation of other mordants, such as fats and tannates, on the same fibre. Cross and Bevan's oxy-cellulose is, as is well understood, a direct preventative to the fixation of aluminium hydrate. Consequently, the fixation of the mordants necessary for the formation of a Turkey-red lake, proceeds on the oxidised fibre less readily, and this appears to be the reason that the colour does not come out full enough.—S. II.

The Use of Antimony Oxalate as a Mordant. C. Bötsch. Chem. Zeit. 9, 1787.

DR. LAUBER recommends the employment of chalk, together with antimony oxalate, to neutralise the acid oxalate of potassium. On the assumption that the chalk is added to the oxalate of antimony previous to the addition of the acid potassium salt, the author points out that calcium oxalate, antimony oxide, carbonate of potassium and free CO_2 , would be formed. The K_2CO_3 formed would act upon a further quantity of antimony oxalate, and precipitate it as basic salt. If the chalk be added when the acid oxalate of potassium is formed, the latter will be neutralised and precipitated. The use of chalk is, therefore, to be condemned.—J. B. C.

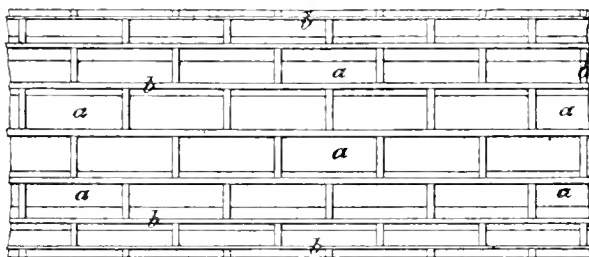
Antimony Oxalate. Chem. Zeit. 10, 148.

AT a meeting of the Société Industrielle de Mulhouse, Weber said that antimony oxalate and oxide, as recommended by Kertesz, have given rise to a great number of investigations, unfortunately with very conflicting results. After repeating his own experiments he is able to confirm his statement that both antimony compounds are very suitable for the fixation of tannin.—S. II.

Paraxyloquinoline. Chem. Zeit. 10, 148.

AT a meeting of the Société Industrielle de Mulhouse (Jan. 13, 1886), Nolting gave some details on paraxyloquinoline. The dicarboxylic acid, $\text{C}_6\text{H}_5\text{N}(\text{COOH})_2$, crystallises from alcohol, is nearly insoluble in water, slightly soluble in absolute alcohol, and melts at 290°C . with decomposition. The acid has also basic properties. Its platinum com-

FIG 2



pound, $(\text{C}_6\text{H}_5\text{N}(\text{COOH})_2\text{HCl})_2\text{PtCl}_4$, forms yellow needles, soluble in water and alcohol. On sulphonating paraxyloquinoline, the sulphonic acid, $(\text{CH}_3)_2\text{C}_6\text{H}_3\text{N}.\text{SO}_3\text{OH}$, is formed, crystallising in white prisms, which are easily soluble in dilute acetic acid, but only slightly soluble in water. The same acid is obtained on heating xylidine sulphonic acid, $\text{C}_6\text{H}_2(\text{CH}_3)_2(\text{NH}_2)(\text{SO}_3\text{OH})[\text{CH}_3 : \text{CH}_3 : \text{NH}_2 : \text{SO}_3\text{H} = 1 : 4 : 3 : 5]$, with glycerol and sulphuric acid, whereas an isomeric acid is obtained from $\text{C}_6\text{H}_2(\text{CH}_3)_2(\text{NH}_2)(\text{SO}_3\text{OH})[\text{CH}_3 : \text{CH}_3 : \text{NH}_2 : \text{SO}_3\text{H} = 1 : 4 : 3 : 6]$, which crystallises in white needles, easily soluble in hot water.—S. II.

VII.—ACIDS, ALKALIS, AND SALTS.

Manufacture of Sodium Chromate and Bichromate. N. Walberg. Dingl. Polyt. J. 259, 188.

Manufacture of Sodium Chromate.—Six parts finely-powdered chrome ore ($44\frac{1}{2}\% \text{CrO}_3$), three parts soda ash ($92\% \text{CO}_2\text{Na}_2$), and three parts chalk, are heated for 5 hours in a reverberatory furnace, which holds a charge of 1 ton at a time. The hot mass is lixiviated systematically in order to produce a liquor of 45°B , which is boiled down in iron pots to 52°B , and allowed to cool in lead-lined tanks, where yellow crystals are deposited, having the composition $\text{CrO}_4\text{Na}_2 \cdot 10\frac{1}{2}\text{H}_2\text{O}$. They are dried at first in a centrifugal machine, and then at a temperature of 30°C , in a drying chamber, where they lose their water of crystallisation, crumbling to a yellow powder of the

composition : $\text{CrO}_3 \cdot \text{Na}_2$, 96.60 ; $\text{SO}_4 \cdot \text{Na}_2$, 0.92 ; insoluble, 0.40 ; water, 1.28.

Manufacture of Sodium Bichromate.—Sodium bichromate being more deliquescent the purer it is—that is to say, the more chromic acid it contains—the author prefers to manufacture a product containing no more than 72.5% CrO_3 , which can be packed in wooden casks. The monochromate crystals, previously mentioned, serve as a raw material. The monochromate solution cannot be directly treated with sulphuric acid for the conversion into bichromate, owing to the partial formation of chromium chromate, which spoils the appearance of the finished bichromate. The monochromate crystals are dissolved in boiling water, until a solution of 40° B. is obtained. Oil of vitriol (chamber acid) is then added in such quantity as to convert the neutral into the acid salt, the end of the reaction being readily determined by potassium iodide starch paper. Neutral salt is then added to the hot liquor, in sufficient quantities to obtain a finished product containing 72½% CrO_3 . The liquor, which now contains sodium sulphate, and the neutral and acid chromate, is allowed to cool in lead-lined tanks, where the sodium sulphate crystallises out. In winter the temperature of the air is sufficiently low, whereas in summer recourse must be had to artificial means of cooling to reduce the temperature to at least 1° C. The mother-liquor is then siphoned off, if necessary filtered, and boiled down to dryness in an iron pot, stirring all the time. The mass consists of hard lumps, which must be ground while in a hot state. The bichromate, thus prepared, forms an orange powder, testing as follows :—

CrO_3	72.50	} corresponding with {	$\text{Na}_2\text{Cr}_2\text{O}_7$	81.59
Na_2O	25.20		NaCrO_4	16.08
SO_3	1.40		Na_2SO_4	2.23
Cl.....	trace			
Insoluble.....	trace			
Water.....	0.10			

—S. H.

Note on Malic Acid. H. J. van't Hoff, jun. Ber. 18, 2713—2714.

Inactive Malic Acid from Monobromosuccinic Acid.—The malic acids obtained both by the author (Ber. 18, 2170) and by Anschütz, from monobromosuccinic acid, are identical with that prepared by Pasteur from aspartic acid, as shown by the form of the crystalline acid ammonium salt. The author prepared his bromosuccinic acid from fumaric acid and hydrogen bromide.

Inactive Malic Acid from Maleic Acid.—The author has obtained an inactive malic acid by the action of sodium and water on maleic acid, in the same manner that Lloyd prepared his inactive acid from fumaric acid. The acid ammonium salt crystallised in the same form as that mentioned above.—S. Y.

The Limit of Decomposition of Sodium Carbonate into Caustic Soda by means of Lime. G. Lunge and J. Schmid. Ber. 18, 3286—3289.

THAT the quantity of caustic potash formed by the action of lime upon the carbonate depends upon the concentration of the solution, has long been known. The authors have studied the question in the case of soda. In the soda industry it is well known that complete decomposition of carbonate into caustic soda never occurs. To effect this more completely, Parnell and Simpson patented a method of operating under pressure. This method has not been practically very successful. The authors' experiments were carried out as follows : Solutions of pure carbonate of soda of different degrees of concentration were heated in iron vessels to boiling for one hour with excess of lime, the water as it evaporated being replaced. With increased pressure, copper tubes, with covers to screw on, were used. The agitation of the liquid was effected by pebbles placed in the tubes, which were heated in a suspended air-bath, capable of swinging backwards and forwards. The analysis of the liquid was made for the total alkalinity with methyl orange as indicator, for the causticity with phenolphthalein, according to Winkler's method.

A. Ordinary pressure :—

Before Causticising.		Sp. gr.	After Causticising.		NaOH from 100 parts Na_2CO_3 .
Percentage Na_2CO_3			I.	II.	
2	....	1.022 at 15°	99.4	....	99.3
5	....	1.052 ..	99.0	....	99.2
10	....	1.107 ..	97.2	....	97.4
12	....	1.127 ..	96.8	....	96.2
14	....	1.150 ..	94.5	....	95.4
16	....	1.169 at 30°	93.7	....	94.0
20	....	1.215 ..	90.7	....	91.0

B. Increased pressure, at a temperature of 148—153° :—

Before Causticising.		Sp. gr.	After Causticising.		NaOH from 100 parts Na_2CO_3 .
Percentage Na_2CO_3			I.	II.	
10	....	1.107 at 15°	97.06	....	97.5
12	....	1.127 ..	96.35	....	96.8
14	....	1.150 ..	95.6	....	96.6
16	....	1.169 at 30°	95.4	....	94.8
20	....	1.215 ..	91.66	....	91.61

The above results show that on the laboratory scale the use of increased pressure has no advantage. These results agree with the experiments of Jurisch, who employed Parnell and Simpson's system on the large scale.—J. B. C.

A New Source of Citric Acid. Amer. Druggist, 1886, 12.

THE red bilberry contains besides 0.2 to 0.3 per cent. of malic acid, from 1.5 to 1.75 per cent. of citric acid. The latter can be obtained as follows :—The berries are crushed in a mill and pressed. The press-cakes are ground with water and pressed a second time. The united juices are precipitated with gelatine, which causes a copious precipitate of tannate and dyestuff. The filtrate is saturated with chalk, heated to boiling, and after collecting the white flakes of calcium citrate, the latter is decomposed in the usual manner. If large quantities of berries are to be had, the manufacture of malic acid and sugar can be taken up at the same time.—S. H.

A Method of Manufacturing Oxide of Iron and obtaining other Useful Products. Thos. Bayley, Birmingham. Eng. Pat. 4228, April 7, 1885. 6d.

METALLIC iron or sulphide of iron is dissolved in hydrochloric acid, the resulting hydrogen or hydrogen sulphide being utilised, and the chloride of iron produced is precipitated by milk of lime alone, or mixed with yellow liquor (made by lixiviating the Leblanc alkali waste), which consists of solutions of alkali earth (or, if preferred, alkali), sulphides and sulphhydrates. The precipitated iron hydroxide and sulphide are washed and separated by the filter-press, and the cakes coloured by roasting; the sulphur dioxide being led into vitriol chambers. Oxidised ores are first reduced and the metal treated as above, the solutions being first filtered from insoluble residue.—W. G. M.

Improvements in the Treatment of Bicarbonate of Soda for obtaining Useful Products therefrom. H. Gaskell, jun., Widnes. Eng. Pat. 4274, April 7, 1885. 8d.

THIS invention relates to the treatment of sodium bicarbonate made by the ammonia soda process, which is always impregnated with ammonia. The bicarbonate is dissolved in water at or near the boiling temperature, and the solution boiled until it is free from ammonia. During the process of boiling, steam, ammonia, and carbon dioxide are given off, which are separated by condensation. The solution of sodium carbonate thus obtained may be allowed to crystallise for the manufacture of ordinary soda crystals, or worked up for the production of mono-hydrated carbonate of soda, soda ash, caustic soda or bicarbonate of soda.—S. H.

Improvements in and in Apparatus for the Manufacture of Carbonate of Soda and Caustic Soda. C. Wigg, Liverpool. Eng. Pat. 4436, April 10, 1885. 8d.

THIS invention relates to combination of apparatus suitable for the manufacture of soda by the ammonia

soda process. It consists essentially of carbonic acid generators and purifiers with saturators, carbonators, filters, furnaces and apparatus for recovering and removing carbonic acid and ammonia. The specification is illustrated by five diagrams.—S. II.

Improvements in the Manufacture of certain Chromates and Acid Chromates. J. Broek and W. A. Rowell, Widnes. Eng. Pat. 5260, April 28, 1885. 6d.

CRUDE sodium chromate is first manufactured in the usual manner and afterwards converted into strontium chromate by precipitation with any suitable strontium salt. This strontium chromate, a nearly insoluble body, is then boiled with a solution of ammonium bisulphate, sodium bisulphate, potassium bisulphate, or aluminium sulphate or bisulphate, according as it is desired to produce ammonium, sodium, potassium, or aluminium bichromate. A mutual decomposition takes place, sulphate of strontia being precipitated. If it be desired to manufacture neutral chromates by this process, strontium chromate is boiled with the sulphate of the base required. But as the normal sulphates of ammonia, soda and potash do not completely decompose strontium chromate with equivalent proportions, it is preferable to use the acid salt and afterwards neutralise the corresponding quantity of free chromic acid existing in the solution. The same reaction can also be applied to the purification, from sulphuric acid or sulphates, of solutions of chromates of the bases named or their bichromates or acid chromates, made by other processes.—S. II.

An Improved Process for the Manufacture of Ammonium Chloride and Potassium Sulphate. W. R. Lake, London. From Schmidtborn and D. Jarves, New York and Michigan, U.S.A. Eng. Pat. 12,745, October 23, 1885. 4d.

The invention depends on the reaction of ammonium sulphate on potassium chloride when present in equivalent proportions. A mutual decomposition takes place—thus: $(\text{NH}_4)_2\text{SO}_4 + 2\text{KCl} = \text{K}_2\text{SO}_4 + 2\text{NH}_4\text{Cl}$. Potassium sulphate may then be separated by "salting out."

—S. II.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Seeger Porcelain. Ztschr. d. Ver. D. Ing. 1885, 29, 578.

THIS manufacture may be regarded as the latest step in the progress of this industry. As the temperature only reaches 1500–1600° (hard porcelain requires 1800–2000°) the palette of the colourist is very much extended, and this circumstance also allows of decoration with under-glaze colours. The choice of coloured glazes is practically unlimited, and amongst these especially rose tints of all shades are readily attainable. Ornamentation with thick coloured enamels is in so far perfected that the burning temperature has been lowered to that of the muffle colours, so that both can now be burnt at one firing. Seeger has further succeeded in producing Chinese red (copper red), a glaze which has only been obtained in some factories in Nankin.—J. B. C.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Manufacture of Cement from Furnace Slags. R. Bosse. Stahl u. Eisen, 1885, 5, 497.

THE puzzolana cement obtained from furnace slag demands increased attention from the fact that the time for setting has been very much diminished. Although the time of setting (about 22 hours) of the puzzolana cement was a valuable property, as it could be more thoroughly worked, it was, on the other hand, a reason against its general adoption because its initial tenacity appeared smaller than that of the Portland cement, the hardening of which occurred in about six

hours. By the method of Wolters and Tetmajer, the time of setting of the puzzolana cement is very much diminished and its tenacity increased.—J. B. C.

X.—METALLURGY. Etc.

Influence of Aqueous Vapour upon the Oxidation of Hydrogen. W. Muller-Erbach. Ber. 18, 3239–3240.

IN a previous communication the author has shown that the temperature of reduction for hydrogen is very much increased in absence of aqueous vapour—e.g., in the case of precipitated oxide of iron from 45° to 285°. The attempt was made to dry the hydrogen in a tube containing CaCl_2 , which, however, as the author has since found, does not perfectly dry the gas. It therefore appears that partial drying of hydrogen decreases its power of reduction. When specular iron ore was heated with hydrogen in presence of CaCl_2 , a considerable quantity of hydrogen, varying with the time of heating, remained unabsorbed. Hammer slag, which readily gives up its oxygen, oxidised nearly all the hydrogen, whereas with moist hydrogen this is not to the same extent the case. The action of aqueous vapour in promoting oxidation consists—firstly, in lowering the temperature of reduction, and in the second place in producing much more rapid reduction. It is still doubtful if in the experiment with specular iron the dilution of the hydrogen is of importance; but the author having found that the water taken up by the CaCl_2 is very slowly absorbed into the inner portion of the salt, and that its minimum tension is thus only reached after a long time, he is led to conclude that the modified action of the hydrogen is due to the decrease in quantity of aqueous vapour present. Mixtures of oxygen or nitrogen act upon moist hydrogen, and nitrogen upon moist carbon monoxide, in a manner similar to that of the dehydration of the gas, as they produce an increase in the temperature of reduction. The action of aqueous vapour appears, therefore, to be opposed to that of oxygen and nitrogen. The behaviour of a dry mixture of hydrogen with oxygen or nitrogen should however be determined.—J. B. C.

Improvements in Coating with Tin, Terne, or other Coating Metal, Sheets, Plates, or Pieces of Iron or other Metal. Edmund Morewood, Llanelly, Carmarthen. Eng. Pat. 3738, March 23, 1885. 11d.

THIS patent relates principally to the removal of scruff or dirt from the coating material and the coated plate. Before passing to the finishing rollers, which work in melted grease as in the usual arrangement, the plates are drawn between cleansing brushes consisting of long surfaces of iron wire, hard wood, brick free from grit, or preferably of tinned iron plate, to which a rapid reciprocating motion is imparted by a pair of eccentrics; beneath each brush is a trough or wash hole to receive the scruff removed, the brush being perforated to allow the dirt to pass through it. In hand brushing the plate is forced by means of a pair of tongs between two hempen brushes, with an adjustable distance between them. Where the plates are removed from the tin-pot horizontally, the excess of surface tin is removed, after traversing a pair of mechanical brushes, by passing between a pair of small tinned rollers working within, and actuated by frictional contact with, a pair of outer rollers also tinned; the excess tin is thus transferred from the plate to the inner rollers, which, in turn, convey it to the larger ones, and by these it is returned to the pot. Conversely, if a thick coat of tin be required, the outer rollers run in a trough of tin, and thus by the aid of the inner pair convey the metal to, instead of from, the plate. Excess of tin and scruff may be removed from the rollers themselves by fixed or movable brushes with wash holes beneath. The surface of the metal bath is freed from dross by a mechanical scraper, which from time to time skims across the metal and carries the dirt into a wash hole placed at the side. A system of coating each plate separately is

also described. Two reservoirs of tin are arranged side by side, in the farther one a number of rollers with brushes work in melted grease, and beneath each pair of brushes is a long narrow trough, these troughs being continued to the first or feeding chamber, but they are contracted at the point of junction to a slit only wide enough to just pass the plate. Between the reservoirs a mechanical scraper, as above described, removes the scum. The plates are fed singly into these troughs, and thus pass out singly to the finishing rollers.

—W. G. M.

Improvements in Treating Waste Liquors from the Manufacture of Tin Plates. W. E. A. Hartmann, Swansea. Eng. Pat. 4478, April 8, 1885. 6d.

THE waste pickling liquors, consisting for the most part of ferrous chloride with an excess of hydrochloric acid, are mixed with caustic magnesia in excess (or with magnesium carbonate and magnesia), whereby magnesium oxychloride is formed, causing solidification of the mass: this mass is then air- or kiln-dried, and finally fired at a red heat, the evolved hydrochloric acid being recovered in condensing towers. The residue consists of ferric oxide and magnesia, which are again used for precipitating a fresh charge; it is used again and again until the contained percentage of magnesia is inconveniently small, when it is treated with an excess of acid liquor and the whole of the magnesia dissolved, the ferric hydroxide being left pure and convertible into the anhydrous oxide.—W. G. M.

An Improved Process for the Manufacture of Iron and Steel direct from the Ore with Gaseous Fuel, and Apparatus employed therein. F. J. P. Cheesbrough, Liverpool. Eng. Pat. 4744, April 17, 1885. 8d.

AT the base of a blast furnace and communicating directly with it, are two open-hearth reverberating furnaces, the gases for which are supplied from a bench of gas producers, the air being heated, as in ordinary practice, by hot-blast stoves. Ore, flux, and coal or coke are charged in as usual—the coke serving to keep the mass open—and the molten metal, instead of collecting in the crucible of the furnace, is run directly and alternately into the open-hearth furnaces, where it may be worked on a basic lining, and after the manner of the Siemens process; or, if foundry pig be required, it may be tapped as required in the usual way. When steel is desired, water gas is employed; otherwise producer gas may be used. If phosphorus be present in any quantity a larger quantity of lime is added with the flux, and yet more is added in the reverberatory furnace. The burnt gases from the open hearths pass to the blast furnace by the channel which conveys the melted metal from it, and are there, by the action of the carbon, reconverted into reducing gases capable of acting upon the ore in the higher zones of the furnace. The requisite pressure is provided by an exhaust fan rather than by the usual blowing engines.—W. G. M.

An Improved Process for Purifying Copper Precipitates. J. Y. Johnson, Lincoln's Inn Fields. From Ernest Deligny, Paris. Eng. Pat. 8418, July 11, 1885. 6d.

FOR the removal of the antimony and arsenic which exist as metallic antimonites and arsenites in the precipitated copper, the precipitate is heated in a concentrated solution of an alkaline nitrate, whereby these salts become peroxidised; the resulting insoluble antimonates and arsenates are next heated with constant agitation in a solution of caustic alkali in a series of vessels, into which the precipitate is fed at one end and gradually transferred to the other, meeting the alkali solution which travels in the reverse direction; thus, the almost pure copper in the last vessel is acted upon by the fresh caustic liquid. By the action of the alkali the antimony and arsenic are removed as soluble salts, leaving instead precipitated metallic oxide with the copper, which may now be finally purified by washing. The alkaline solution

may be used again after treatment with caustic lime, which precipitates the antimonates and arsenates. If preferred, a dry method may be employed. The crude precipitated copper is heated to dull redness with a sufficient quantity of an alkaline nitrate, which oxidises the impurities as above, and becomes converted into free alkali, thus completing the reaction in the same stage; it only remains, then, to lixiviate the mass and collect the purified copper.—W. G. M.

XII.—PAINTS, VARNISHES, AND RESINS.

Improvement in Vulcanising Soft Rubber, and Process of Making the same. F. Willhöft, New York. Eng. Pat. 7914, June 30, 1885. 6d.

THE defects of all vulcanised goods now manufactured are due to an excess of sulphur, which effloresces, causing "bloom," and also eventually renders the goods brittle, the large quantity of sulphur, 6–12 per cent., being necessary on account of the temperature (280–300° F.) at which vulcanisation is ordinarily effected. By the use of a temperature of 330–350° F. the patentee claims to be able to effect complete vulcanisation of the rubber without an excess of sulphur, of which he uses 3½–5 per cent. The heating is effected by means of steam at 112lb. pressure, and the whole process only requires about one-third the time usually taken.—E. E. B.

XIII.—TANNING, LEATHER, GLUE, AND SIZE.

The Preparation of Skins, Kips, and Hides, by an Improvement in the Process known as "Puring" or "Bating." Alfred James Hailes. Eng. Pat. 457, January 12, 1886. 4d.

THE skins, kips, or hides are immersed in a bath of acetic acid, with or without chlorhydric or other acid or acids, and treated precisely as in the ordinary process of "puring." The strength of the bath is entirely dependent on the quality of the skins and their mode of preparation.—B. H.

Manufacture of a Substitute for Caoutchouc and Gutta-percha. A. M. Clark, London. From J. J. Hang and C. Hoffmann, both of St. Petersburg. Eng. Pat. 1108, January 25, 1886. 4d.

UNHAIRIED skins are digested with 5 per cent. of glycerine (crude) and a minimum of water in a Papin's digester until complete solution is effected. The thick, tenacious mass thus obtained is treated with an equal quantity of glycerine and one-twelfth of its weight of a concentrated solution of potassium bichromate, potassium chromate, or equivalent substance; it is then poured into moulds, left to solidify under pressure, and finally dried in an airy dark room. The product is similar to caoutchouc, but withstands heat much better; it may be rendered acid- or water-proof, very elastic or as hard as glass by altering the above proportions and adding various substances.

—E. E. B.

XIV.—AGRICULTURE, MANURES, Etc.

Notes on Grinding Thomas-slag. Horn. Berg. u. Hüttem. Ztg. 1886, 45, 40.

THE principal difficulty in grinding Thomas-slag is the presence of metallic iron. After many experiments, the author comes to the conclusion that it is best to crush the slag roughly in roller-mills and sort it afterwards in slanting sieves (Nagel and Kämp's patent). By this means the iron can be removed. The disintegration to a very fine powder may then be performed in horizontal mills. A large works for grinding Thomas-slag is now in course of construction at Ruhrort, Westphalia (Phenix).—S. H.

Manurial Experiments with Slag from Thomas-Process. H. Bieler, jun. Bied. Centr. 15, 29–30.

EXPERIMENTS were conducted with oats, on medium heavy loam, the crop of the previous year being carrots

manured with stable manure. In the one case the slag, in conjunction with nitrate of soda, did not prove economical; whilst in the other experiment, in conjunction with nitrate of soda and kainite, it did so.—D. A. L.

Durability of the Germinating Power of Beet-root Seeds.
G. Marck. Bied. Centr. 15, 54—58.

THE author's experiments with fresh and old beet-root seeds indicate the following as the order of excellence with regard to germinating power:—1st and best, seeds one year old; 2nd, seeds three and four years old, about equal; 3rd, seeds freshly gathered and two years old. Seeds five years old and older show a marked and increasing decrease in germinating power. Arranged numerically they stand as follows: Of seeds up to four years old, 90—100 per cent. germinate; of seeds five to seven years old, 45—55 per cent.; whilst of seeds nine years old, only 24 per cent. germinate.—D. A. L.

Occurrence of Coniferin and Vanillin in Asparagus.
E. O. v. Lippmann. Ber. 18, 3335—3336.

THE peculiar after-taste of vanillin, which asparagus (especially the preserved vegetable) imparts, led the author to examine it for this substance. The same method was adopted as that employed in isolating it from the sugar-beet. In this way the author succeeded in separating a small quantity of vanillin and a much larger amount of coniferin, both of which were identical in physical properties with the bodies prepared from other sources.—J. B. C.

XV.—SUGAR, GUMS, STARCHES, Etc.

The Monostrontium-saccharate Process. C. Scheibler.
Neue Ztschr. f. Zucker-Ind. 1886, 16, 1.

MOLASSES are treated with so much of a hot saturated strontium hydrate solution that for each part of sugar one part of strontium oxide is present. After the solution is complete the mass is allowed to cool and stand for three to six hours in order to crystallise out the monosaccharate. The latter is separated by filter-presses, washed with a small quantity of water or juice, carbonated, and the 20 per cent. sugar solution thus obtained worked up as usual. The mother-liquor of the monosaccharate, which still contains about 30 per cent. of sugar, is treated with so much strontium hydrate that for each part of sugar there are three-and-a-half parts of the hydrate, boiled for eight to ten minutes and allowed to stand. Bisaccharate falls down, and is mixed with so much molasses that a monosaccharate solution is formed, which is treated as previously described. The strontium carbonate resulting from the carbonation is decarbonated, and serves again for the formation of the monosaccharate. It is claimed for this process that it yields concentrated juices, and no raffinose being formed, it is said to be the cheapest and simplest of all processes for the recovery of sugar from molasses.—S. H.

The Manufacture of Maltose. Neue Ztschr. f. Zucker-Ind. 1886, 16, 32.

ONE part of green or partially-dried malt is warmed with two to three parts of water, digested for several hours at 30° C., and afterwards filter-pressed to obtain an "infusion" of malt. One part of starch-flour is then suspended in two to twelve parts of water and 5 to 10 per cent. of infusion, the whole gradually warmed to 80° C., then heated under a pressure of 14 atm. for thirty minutes, quickly cooled to 45° C. and treated with 5 to 20 per cent. of infusion and hydrochloric acid (from 6 to 25 cc. HCl per 100 litres). After one hour the mass is filtered through filter-paper fastened or cemented upon linnen-cloth. The solution is allowed to stand at 48° C. for twelve to fifteen hours, then concentrated to 25° B., filtered, again concentrated to 35° B., filtered through animal charcoal, and allowed to crystallise.—S. H.

Process for the Recovery of Sugar from Molasses.
Sucrerie Indigene, 1886, 27, 5.

100 KILOS. molasses are mixed with 150 litres of alcohol, containing 5 per cent. of sulphuric acid. Sulphates are precipitated, which are filtered, some benzene being added to the filtrate. Sugar is deposited in a very pure state in the form of a heavy syrup. The latter is washed with a mixture of alcohol and benzene, and then concentrated without further purification. Benzene is separated from alcohol by the addition of water, and both benzene and alcohol are recovered by distillation.—S. H.

Improved Scheibler Apparatus for the Extraction of Sugar from Beet. C. Scheibler. Bied. Centr. 15, 71 (Zeits. Rübenzucker, Ind. 14, 286—287).

THE object of the present improvement in this apparatus is to prevent the condensed spirit percolating too rapidly through the root-mass, and in this way to ensure more perfect extraction. Previously, the spirit, after percolating, passed into a second open tube (a jacket-tube) and thence into the flask. It is now proposed to close this second tube at the lower end, to pierce it with holes above the level of the root-mass in the inner tube, and to envelope it in a third tube connected with the flask. When the improved apparatus is in operation the root-mass, by means of the suggested modification, is kept constantly covered with spirit, and is hence more likely to be well extracted.—D. A. L.

On the Raffinose or Melitose obtained from Molasses, Cotton-seed, and Eucalyptus-manna. P. Rischbiet and B. Tollens. Ber. 18, 2611—2616.

THE isolation of a sugar of high rotary power from molasses has been already described by Tollens (this Journal, 1885, 290—291; Ber. 18, 26), and its similarity to Loiseau's raffinose and Ritthausen and Böhm's sugar from cotton-seed was then pointed out. The results described have been confirmed by Loiseau and by Scheibler, who, however, proposed the formula $C_{18}H_{32}O_{16} + 5H_2O$ for the sugar, instead of that adopted by Ritthausen and by Tollens— $C_{18}H_{32}O_{16} + 3H_2O$.

The properties of the raffinose from both molasses and cotton-seed have been carefully investigated by the authors, and their identity established. The rotary power $[\alpha]_D$ is 104—104½°, but after warming with acid for a short time, 48—49°. Raffinose ferments readily with yeast, and yields nearly the same quantity of alcohol as cane-sugar. By continued heating with acid, levulinic acid was obtained; the phenylhydrazine compound was prepared, and the reducing power of inverted raffinose was estimated with Fehling's solution, and was found to be less than that of dextrose. The loss of water on heating to 70—80° was 14.5—15 per cent., corresponding to the formula $C_{18}H_{32}O_{16} + 5H_2O$; but at 100° more water was given off, so that some doubt may exist as to the true amount. In moist air all the water is again taken up. With caustic soda and alcohol, raffinose yields a compound containing 6 to 7 per cent. of sodium, the formula $C_{18}H_{32}NaO_{16}$ corresponding to 6.32, and $C_{18}H_{32}O_{16}.NaOH$ to 6.02 per cent. of that metal.

By oxidation with nitric acid, raffinose was found to yield from 22—23 per cent. of mucic acid, while galactose gives 74—77, and milk-sugar 36—38 per cent. The formation of this amount of mucic acid is a strong argument against the formula $C_{18}H_{32}O_{16} + 3H_2O$, but agrees with the other, $C_{18}H_{32}O_{16} + 5H_2O$, if it be assumed that a molecule of raffinose contains one galactose group ($C_6H_{12}O_6$). On the other hand, a monosodium compound corresponding to the second formula would contain 4.23—4.37, and a disodium compound 7.88—8.38 of sodium, the amount found being 6—7 per cent. It is therefore probable that the molecular weight is higher than is expressed by either formula. All the facts could be explained by adopting the formula $C_{36}H_{64}O_{52} + 10H_2O$, and the rotary power of inverted raffinose might be deduced from it by taking account of the various bodies formed—galactose, levulose, dextrose, and a dextran or dextrin group. The dextran or dextrin group would, while present, prevent the crystallisation of the inversion

products, and its conversion by the continued warming of raffinose with acid into glucoses would account for the gradual decrease of rotary power.

Of the other products the authors believe that they have isolated galactose and levulose, and possibly dulcitol.

Melitose from Eucalyptus-manna, by B. Tollens.—Having obtained 22.5 grms. of the manna from Baron F. v. Müller, in Melbourne, the author investigated this compound, and by careful purification obtained 10.5 grms. of melitose from 20 grms. of the crude substance. The percentage of water was found to be 14.67, and the rotary power 104.00—104.44° for (α)_D at 20°. The identity of raffinose and melitose is thus proved, and the older name, melitose, may now be applied to the sugar from all these sources.—S. Y.

XVI.—BREWING, WINES, SPIRITS, Etc.

Improvements in Apparatus for Heating Wine and other Liquids. A. Browne, Middlesex. From A. Fromm, M. Ballo, and F. T. Kugler, Buda-Pesth, Hungary. Eng. Pat. 1851, February 10, 1885. 8d.

THIS is an apparatus for Pasteurising wine or other liquids, and generally for heating water for household or other purposes, to a temperature less than 100° C. It consists of a coil, heated either by a fire direct, or immersed in a jacket of hot water, through which the wine or other liquid is made to circulate by an arrangement of tubes inserted in the bung-hole of the cask. It is claimed that the apparatus fulfils all requirements both of theory and practice—viz., that the wine shall be heated from below; that the wine, once heated, shall not come in contact with the air; and that the wine shall not come into contact with surfaces heated to 100° C.—G. H. M.

Improvements in the Manufacture of Beer and Malt Liquors, and in Apparatus for the Treatment and Preparation of Materials for the same. W. Lawrence, London. Eng. Pat. 4068, March 31, 1885. 11d.

THIS is a process for treating malted grain in such a way that in the process of brewing a beer is obtained which is entirely unlike either the English "top-fermentation" beer, or the Lager "bottom-fermentation" beer. The process includes improvements in grinding the malt, in mashing and straining the wort, and in fermenting the same. The mash is made with the help of an injector (Eng. Pat. 4277, 1882, and 1205, 1883), which mechanically bursts the starch granules of the malt at a low temperature, 100—115° F., and consequently allows the diastatic action to run down to a lower point with the formation of a low dextrine. The fermentation is carried on with a small quantity of yeast, preferably "French" yeast, and in small vessels. The resulting beer, which the inventor styles "distinctive" beer, is said to be free from acidity, to possess good keeping properties, to be highly stimulating, but much less intoxicating than ordinary beer, and, at the same time, digestive. A full description of the plant used, which includes a modified grinding arrangement, special mash-tun, filtering apparatus, and fermentation vessel, are described in detail, and directions are also given for a complete brew on the inventor's system.—G. H. M.

Improvements in Apparatus for Raising Beer. W. J. Chadwick, Salford. Eng. Pat. 4380, April 9, 1885. 8d.

THIS is an apparatus to be used instead of pumps for raising beer from one level to a higher level; for instance, from a cellar to the place of consumption. For this purpose a pressure of air, or preferably carbonic acid gas, is obtained by connecting a close chamber with a reservoir of water, placed at a sufficient height to give the required pressure. When carbonic acid gas is used, it is necessary to either use oil in the reservoir, or cover the water in the close chamber with a layer of oil, in order to prevent absorption of the gas by the water. The carbonic

acid gas is generated in an apparatus connected with the close chamber under sufficient pressure to force the liquid back into the reservoir. The gas space in the chamber is connected with the casks of liquid in the ordinary way.—G. H. M.

Modes of Treating and Utilising certain Waste Products obtained in Brewing and Similar Processes. J. C. Mewburn, London. From G. Noback and Dr. W. Gintl, Prague, Bohemia. Eng. Pat. 6243, May 21, 1885. 6d.

THIS consists of a process for easily recovering the bitter and resinous matters of hops from the various sediments and deposits occurring in brewery vessels, and also from spent hops. These sediments, etc., are dried either atmospherically or by the aid of heat, and then thoroughly extracted with hot strong alcohol. The alcoholic extract is allowed to cool, filtered, and the alcohol distilled off. The residue from the alcohol is then successively treated with sodium carbonate solution until nothing more is taken up. The residue is then dried and constitutes *hop resin*. The sodium carbonate solution is precipitated with acid, and the light yellow precipitate obtained filtered off and washed with water; this substance is the *hop bitter*, and may be used to replace a portion of the hops in brewing, and also to increase the "foaming" power of beer. The hop resin may also be used in beer, as well as for preparing a varnish for brewing vessels and storage casks.

The preparation of the above substances may be varied by treating the waste products directly with a 5 per cent. solution of sodium carbonate, and subsequent treatment of the residue with wood spirit, carbon disulphide, etc., or by direct treatment of the waste products with the latter solvents.—G. H. M.

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

(A) CHEMISTRY OF FOODS.

The Influence of Foods on Digestion. M. Ogata. Chem. Centr. 16, 665.

THE author has arrived at the following results, based upon experiment: Water, carbonated water, tea, and coffee taken moderately, do not influence digestion; beer, wine, and brandy retard at first, until they are assimilated; and with beer, the alcohol as well as the extractive substances have the same effect, which accounts for the fact that beer retards digestion much more than wine containing an equal amount of alcohol. Sugar (cane and grape sugar) slackens digestion; salt has the reverse effect. It has not been determined whether this retarding action has a good effect on the organism, or whether, on the contrary, it is injurious.—J. B. C.

(B) SANITARY CHEMISTRY.

Injurious Action of Factory and Domestic Drainage on Fish and on Fish Culture. C. Wiegelt, O. Saare, and L. Schwab. Bied. Centr. 15, 1—9.

FOR the investigation of this subject, fish were placed in water containing specified impurities in definite quantities, and the effect produced in them was noted. As examples of hardy fish, tench were selected for experiment, whilst delicate fish were represented by trout and salmon. In some cases the fish sickened, but recovered on removal into fresh water; in other cases they sickened past recovery, or died at once; whilst under some other conditions they remained unhurt. Several circumstances affect the results—for example, the species of fish, some withstanding the action of foreign matter better than others. Nevertheless the same impurity produces the same symptoms in individuals of the same species. The heavier and older fish are less susceptible than the smaller and younger ones; and, moreover, the higher the temperature, and the

greater the concentration of the solution, the more potent is the action of the injurious substance; whilst the length of the period of exposure exercises considerable influence on the result. In the following table some of the authors' results are given. The time of exposure, when not otherwise noted, is 24 hours for tench, and 1 hour for trout. If the fish did not expire within three days after treatment, the substance they had been subjected to was deemed harmless. When no kind of fish is specified in the original paper, the entry is marked thus *.

assumed to be of absolute value for pronouncing judgment as to the injurious qualities of any drainage.

—D. A. L.

Improvements in Purifying and Deodorising Sewage, etc.
F. M. Lyte, Putney. Eng. Pat. 900, January 21, 1885. 6d.

THIS specification is that taken out January 21, No. 900, and abstracted in a former number of this Journal, amended. Leave has been granted to its author to

SUBSTANCE EMPLOYED.	Quantities in Parts per 1000.					
	Harmless.		Injurious.		Fatal.	
	Trout.	Tench.	Trout.	Tench.	Trout.	Tench.
Sulphuric Acid	0.05	0.50	0.10 (2-6 hours)	—	—	—
Hydrochloric Acid	—	—	—	—	1.00	1.00
Nitric Acid	—	—	0.10	—	—	—
Sulphurous Acid	0.005	—	0.001	—	0.001	0.001
Carbonic Anhydride	(in one expt)	—	(in one expt)	—	0.10* (immediately)	0.10* (in a few minutes)
Phenol	0.005	0.01	0.05	—	0.01-0.005	0.05-0.01
Chlorine (Chloride of Lime) ..	0.0005 (2½ hours)	0.001 (3 hours)	—	—	0.0008	0.01-0.005
Mercuric Chloride	—	—	—	—	0.05 (immediately)	0.10 (immediately)
Copper Sulphate	} If quickly	transferred to	fresh water	0.101 (at 8° C.)	0.10 (in a few minutes)	1.0 (at 20° C.)
Potassium Cyanide					0.005 (in a few minutes)	0.01 (at 20° C.)
Sodium Sulphide	—	0.1 (30 minutes)	—	0.101 (at 8° C.)	—	0.115 (at 20° C.)
Ammonia	0.01*	—	intermediate	between	chlorine and	the acids
Soda	3.0*	—	5.0 and 10.0 (after 3 hours)	—	1.0 (after prolonged action)	—
Hydrogen Sulphide	—	—	—	—	0.01 and 0.001 (soon)	0.01-0.001
Carbon Disulphide	—	—	—	—	like hydrogen sulphide	—
Iron Salts	—	1.00 (16 hours)	5.0 (3 min.) 1.0 (23 " 0.5 (27 "	—	0.1 (16 hours)	—
Aluminium Salts	0.05	1.00	10.00	—	—	—
Amyl Alcohol	When treated with fresh water		1.00	—	—	—
Tannic Acid	0.1	10.0	10.0 (½ an hour)	—	—	—
Tar	—	—	0.2	10.0	—	—
Calcium Chloride	1.0	10.0 (at 6° C.)	—	—	—	10.0 (at 20° C.)

The following have been found harmless for trout:—Oxalic acid, 0.01 per cent. for half-an-hour; ammonium carbonate, 3.0 per 1000 for half-an-hour; manganous chloride, 1.0 per 1000 for 5 hours; ammonium thiocyanate and potassium ferrocyanide, 1.0 per 1000 for 1 hour. The following for tench: Manganous chloride, 5.0 per 1000 for 22 hours. And for both sulphites, and arsenic acid or sodium arsenate, 0.1 per 1000; glycerol, and oils which cover the surface of the water (tench can exist 20 hours with air excluded), methyl and ethyl alcohol, 10.00 per 1000; sodium chloride 10.00 per 1000. Lime, however, is very injurious, probably from the formation of calcium carbonate in the gills. Suggestions are made, founded on the above results, as to the regulation and mode of treatment of factory refuse and drainage. It is still a question whether by prolonged existence in extremely dilute solutions of injurious substances, the fish do not suffer chronic poisoning. Unimpregnated eggs resist the action of impurities to an extraordinary extent; but impurities, when present in quantities not under 0.1 per 1000, act injuriously on impregnated and fertilised eggs, apparently weakening their power of development. Dilute fermented sewage is extremely injurious to trout, etc.; the injurious effect can be traced to the large quantity of poisonous gases present, and to the deficiency of oxygen, without taking bacteria, etc., into consideration. The authors point out that the above numerical data are not

amend his specification, that the terms in the original specification may be narrowed, so as not to include reagents which it is not desirable to employ.—C. C. H.

An Improved Method of Purifying Drainage Waters and Sewage. M. Nahsen, Schönebeck-a-d-Elbe. Eng. Pat. 5348, April 30, 1885. 6d.

"PHOSPHORIC SLAG" is disintegrated with water into a pulp; from one to two kilogrammes are added to a cubic metre of the sewage. The defecating effect may be increased by the addition, either before or after adding the slag, of dissolved magnesium argillaceous earth, iron or manganese salts. When these latter are omitted, hydrated silicic acid may be added to secure additional clarification, and to correct the alkalinity of the sewage.

—C. C. H.

Improvements in Water Filters. E. Johnson, London. Eng. Pat. 5524, May 5, 1885. 8d.

A BELL-SHAPED vessel with a pear-shaped bulb at the end is inverted over a receiving vessel. The bulb is filled with granulated carbon and "carbon cloth"; the neck of the bulb is stopped with a hollow plug of so-called "feral carbon" filled with carbon cloth, and the lower end provided with a small orifice for the escape of the filtered water.—C. C. H.

An Improved Filter. J. Howie, Kilmarnock. Eng. Pat. 5792, May 9, 1885. 8d.

THIS invention is for an improved form of water filter. The medium is made by mixing together sawdust and clay; two parts of the former and one part of the latter are suitable proportions. This mixture is made into a paste with water, moulded into the desired shape, and burned in a kiln. Sometimes burnt clay, broken biscuitware, asbestos or silicate of soda are added to the mixture. The general form and method of using the filter is similar to those extensively in use, the patentee confining his claims for novelty to the preparation of the porous carbonaceous porcelain ware.—C. C. H.

Improvements in Sewage Purification Processes, etc. F. M. Lyte, Putney. Eng. Pat. 6054, May 16, 1885. 6d.

THIS patent claims improvements on that taken out by the same author, Eng. Pat. 900, January 21, 1885. In the former patent, sewage or water purification was effected by the addition to the sewage or water of a small quantity of a soluble aluminate, preferably sodium aluminate, and it was stated that a small quantity of an acid, a salt of alumina, or any acid salt, should be previously added to produce decomposition of the aluminate and precipitation of the hydrated aluminium oxide. It is now found that other salts, such as calcium sulphate and chloride salts of magnesium or zinc, produce the same result. The patentee therefore claims the use of a neutral earthy or metallic salt in conjunction with a soluble aluminate for the purpose specified; (2) the use of an aluminate for softening waters in which salts of lime or magnesia are already present.—C. C. H.

Improvements in Treating and Drying Excreta, and Manufacturing the same into Manure. W. Grimshaw, Ashton-under-Lyne. Eng. Pat. 6453, May 27, 1885. 4d.

EXCRETA collected by the "Pail system" is mixed in a pug mill with dried excreta and cotton or woollen waste. It is moulded into blocks, dried in a kiln and finally pulverised. The kiln is heated direct with the products of combustion, from a furnace mixed with sulphurous acid gas, and after passing through the kiln, the gases are passed through a deodorising chamber, and thence into a furnace heated to incandescence.—C. C. H.

An Improved Method of Continuous Filtration applicable to the Purification of Sewage, etc. G. H. Leane, London. Eng. Pat. 1053, January 23, 1886. 6d.

A RECTANGULAR tank is divided up by longitudinal walls forming a series of long narrow channels fed by sewage from a common inlet. Inside each of these channels another channel of a smaller sectional area is constructed, having porous sides and a porous bottom. The sewage filters through the porous walls into the interior of the second channel, and runs away from the end of the tank opposite to that at which it entered. The walls of the filtering channel are formed by two sheets of perforated material, iron, wood, etc., packed between with carbon produced from the distillation of Kimmeridge shale. The suspended matters remain on the outside of the filtering channel and are deposited in the space betwixt it and the main chain. The patentee claims the combination of the arrangements as described.—C. C. H.

(C) DISINFECTANTS.

A Method of Disinfecting or Purifying Foul Water. H. J. Haddan, London. From G. Langbein, Leipsic. Eng. Pat. 4714, April 16, 1885. 6d.

AN aqueous solution of sodium nitrite (or any soluble nitrite) of a strength such that 100 litres of the solution contain 69 kilos. of the sodium nitrite, is mixed with an equal volume of dilute sulphuric acid containing 5 kilos. of acid in 1000 litres of water and added to the foul water or sewage. The nitrous acid set free is oxidised

by the atmospheric oxygen, and the hyponitric acid produced acts upon the organic matter present, nitrous acid being again produced; the process is therefore repeated so long as organic matter capable of being oxidised remains present. The patentee states as an advantage that all organisms originally present are destroyed.—C. C. H.

XVIII.—ELECTRO-CHEMISTRY.

The Application of Electricity for Silvering. G. Zinin. Dingl. Polyt. J. 1886, 259, 26.

THE author succeeded in replacing the poisonous silver cyanide bath by another solution, which can be kept without decomposition for any length of time, and is not acted upon by sun-light. The new bath consists of an aqueous solution of silver potassium iodide, and is made up by dissolving 6.66 grms. of silver nitrate in 1000 cc. of water, and adding 500 grms. of potassium iodide. Copper objects are prepared in the same manner as in using the cyanide bath. A plate of pure or alloyed silver serves as anode. The electric current must be very weak, so that no free iodine is deposited on the anode, although free iodine does not spoil the bath, since it can be made to combine again by the addition of a small quantity of potassium hydrate. From ten to thirty minutes are usually sufficient for silvering, and after immersing the silvered object in a bath of one part of potassium iodide in four parts of water, it may be polished. The new bath is more expensive than the cyanide bath, but considering that any thickness of silvering can be produced with the further advantage of far greater expediency and simplicity, it will repay the extra cost for chemicals.—S. H.

Improvements in the Process of and Apparatus for Separating Metals from their Alloys and other Compounds. J. J. Sherlock, Barnet. Eng. Pat. 4829, October 10, 1883. 4d. Received Provisional Protection only.

A STORE TANK, containing a suitable solvent for the metals it is desired to extract, is arranged to supply into a vessel within which is a porous cell. Into this cell the excess solvent overflows, and is constantly removed from beneath to a series of porous walled compartments contained in a depositing tank. The alloy to be treated forms the anode in the inner porous cell to a voltaic current; the more electro-positive metals dissolve and the solution passes to the depositing tank, where in the successive compartments it is submitted to the action of a series of metals each more electro-positive than the last, and so selected that each in order will effect the displacement of one of the dissolved metals without affecting the others. The treated liquid is then to be restored to the store tank.—W. G. M.

Improvements in and relating to Electrical Accumulators, or Secondary Batteries. W. R. Lake, London. Eng. Pat. 2765, March 2, 1885. 6d.

THIS invention relates more particularly to the employment in electrical accumulators, or secondary batteries, of plates composed of chloride of lead with from three to ten per cent. of chloride of zinc or other suitable metallic chloride, thereby preventing breakage of the plates and ensuring great porosity of the mass by the elimination first of the chlorine and then of the zinc or other metal.—W. B.

A System of Photo-telegraphy. W. Gemmill, Kirk-maiden, Wigton. Eng. Pat. 4841, April 20, 1885. 6d.

THE author claims as his invention, the arrangement by which a selenium-celled electrical circuit is connected with a separately supplied one, or series of separately supplied ones, lighting an electric lamp in such a manner that, when light or shadow falls on the selenium cell, the light of the lamp flashes out or becomes more or less extinguished, as the case may

be; and, further, the varying of the illumination by the lamp with the degree of light falling on the selenium so as to make the lamp available alike for the transmission of writings, drawings, paintings, and other gradually shaded pictures—through the medium of telegraphic wires—and for their reproduction faithfully photographed. It employs the varying current, passing through the varying lighted selenium cell, to excite the distant electro-magnet, which for the transmission of simple outlines throws on and off the current to an electric lamp—or, it may be, turns the stop-cock of a gas-jet—and for shaded pictures switches on a greater or less number of subsidiary currents to the lamp, according as more or less light falls on the selenium.—W. B.

Improvements in Galvanic Batteries. A. Schanschickl, Surrey. Eng. Pat. 5202, April 27, 1885. 4d.

To avoid local action in a galvanic battery, and to render its current constant, the author proposes to coat the positive, and in some cases the negative, plates with collodion, gelatine, or other like protective coating.—W. B.

Improvements in Galvanic Batteries. A. R. Upward and C. W. Pridham, London. Eng. Pat. 7461, June 18, 1885. 8d.

A BATTERY CELL is constructed with a zinc element immersed in a solution of chloride of zinc separated by a porous diaphragm from a carbon element around which chlorine gas circulates.

The chloride of zinc around the zinc element operating electrolytically, local action is avoided, whilst at the same time the full electromotive force due to zinc burning in free chlorine is obtained.—W. B.

Improvements in Galvanic Batteries. W. W. Popplewell, Southampton Buildings, London. From F. L. O. Lathrop, J. W. Carter, and C. Faber, New York. Eng. Pat. 1151, January 26, 1886. 8d.

THE invention consists of a metallic jar or cell, that is lined in the interior with rubber or other acid-resisting material, the said rubber lining being extended over the edge of the jar, of a porous cup provided with enlarged rounded ends and parallel sides that approach closely to each other, a zinc made in the form of a screw, with one or more threads, and provided with a depression or pocket at its top part that communicates by a hole with the screw-thread, so as to supply the mercury for amalgamating the zinc while in use and without removing it from the jar, and of carbons made in the form of plates, and provided with conical or diamond-shaped projections or teats at both sides.—W. B.

An Improved Electrode for Secondary Batteries. H. J. Allison, London. Eng. Pat. 1354, Jan. 30, 1886. 6d.

AN electrode for secondary or storage batteries having a new construction of the metal framework or retaining plate, and a new composition, which is inserted in and supported by the said plate.—W. B.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

On the Alkaloids from Fennugreek Seeds. E. Jahns. Ber. 18, 2518–2523.

THE frequent occurrence of alkaloids in the seeds of papilionaceous plants induced the author to examine those of fennugreek (*Trigonella junium gracum*). Two alkaloids were obtained, choline, and another which the author names trigonelline. Possibly a third was also present in small quantity.

The pulverised seeds were extracted with seventy per cent. alcohol, and after evaporation the residual liquor was precipitated with lead acetate and soda. After

removal of lead from the filtrate and evaporation, the alkaloids were precipitated by potassium-bismuth iodide and sulphuric acid. The bases were only completely precipitated after some weeks, and were then converted into the mercuric iodide compounds to separate albuminous matter. The bismuth compounds were decomposed by soda; the filtrate carefully neutralised with sulphuric acid, and mercuric iodide added until no more potassium iodide remained. In this way only the choline salt was precipitated. After filtration the solution was acidified with sulphuric acid, when the trigonelline compound separated in oily drops, which rapidly solidified. By evaporation of the mother-liquor and addition of mercuric iodide, the remainder of the trigonelline compound was precipitated. The yield of choline was about 0.05 per cent., and of trigonelline, 0.13 per cent.

The free bases were separated and purified in the usual manner. The choline was identified by the formation and analysis of the platinum and gold salts. The crystalline form of the platinum double salt was also determined.

Trigonelline, $C_7H_{11}NO_2 + H_2O$, crystallises from alcohol in colourless prisms, which possess a weak saline taste. It is hygroscopic and easily soluble in water, but is insoluble in ether, chloroform, and benzene. The solutions are neutral. Potassium-bismuth iodide gives a brick-red precipitate in acid solutions, and a bulky precipitate is formed with phospho molybdic acid. Tannic acid produces a turbidity. Gold chloride and bromine water give precipitates only in concentrated solutions. Analyses of the free base, the hydrochloride and the platinum and two gold double salts were made.

Trigonelline is isomeric and probably identical with pyridine-betaïn, prepared by v. Gerichten by heating pyridine with monochloroacetic acid, the only difference being that pyridine-betaïn hydrochloride is coloured blue by sodium amalgam, and trigonelline yellow. By heating trigonelline with concentrated caustic potash, a distillate is obtained which appears to contain pyridine.—S. Y.

Synthesis of Vanillin. M. Ulrich. Ber. 18, 2571–2573.

The four metamethoxymononitrobenzaldehydes.—A method of preparation of *m*-methoxynitrobenzaldehyde, yielding three isomers, was patented by Messrs. Meister, Lucius & Brüning (Ger. Pat. 18,016) in 1881. The formation of the isomeric mononitro compounds was called in question by Tiemann (Ber. 15, 2043 and 3052; this Journal, 1883, 268–269), and later by Schnell (Ber. 17, 1381), but is confirmed by the author. Metamethoxybenzaldehyde was treated at 0° to 10° with nitric acid of specific gravity 1.46 until a drop of the mixture, rubbed with water on a watch-glass, crystallised rapidly. The product, when recrystallised from benzene, separated in three portions. Of these, the first and largest consisted of a nitrometamethoxybenzaldehyde, an ortho-derivative, as proved by its giving the indigo reaction. The crystals melt at 167°. The second small portion crystallised in needles, melting at 82–83°, and was similarly shown to be an ortho-derivative. It is named β -nitro-*m*-methoxybenzaldehyde. Lastly, compact crystals of γ -nitro-*m*-methoxybenzaldehyde, melting at 97°, were deposited. This compound formed snow-white needles, melting at 126°, when treated with acetone and caustic soda. It proved to be the meta-derivative, for the author succeeded in preparing the remaining isomer, a para compound, by a different process. Metanitrobenzaldehyde was converted into methyl-*m*-methoxybenzoate, and this was treated as above with nitric acid. The paranitro compound thus prepared crystallised from alcohol in white needles, melting at 163°. The ether was saponified with 0.5 per cent. caustic potash, and oxidised in the alkaline solution with permanganate. Paranitrometamethoxybenzaldehyde crystallised in part from the filtered solution in very fine needles, melting at 62°. The remainder was extracted with ether. This compound, when treated with acetone and caustic soda, forms a compound which crystallises in fine needles, melting at 84°. By replace-

ment of the nitro group by a hydroxyl group (Ger. Pat. 18,016) *p*-nitro-*m*-methoxybenzaldehyde is converted into vanillin.—S. Y.

Japanese Medlar. J. Peckalt. Ztschr. Oesterr. Apoth. Ver. 1886, 24, 1.

THE Japanese medlar (*Eriobotrya japonica*), a tree from 5 to 6m. high, has been transplanted from its home to Brazil with the greatest success. Its fruits are yellow, of the size of a plum, and contain from 2 to 5 blackish, brown seeds. By fermentation of the fruit, a drink can be prepared, which is exactly like the Swiss "Kirschwasser" as regards smell and taste. On distilling the crushed seeds with steam, the *aqua Eriobotryae* is obtained, which contains 0.05 per cent. of hydrocyanic acid, and cannot be distinguished from *aqua Lauracerasi*. The leaves of the medlar proved a very effective cure against chronic diarrhoea.—S. H.

Paraquinanisol. Z. H. Skraup. Monatsh. f. Chem. 6, 760—784.

78GRMS. anisidine, 50grms. nitranisol, 320grms. glycerol and 125grms. strong sulphuric acid are heated with an inverted condenser for two hours, and then with a further addition of 50grms. H_2SO_4 for two hours more. Unchanged nitranisol is distilled off by steam, and anisidine and quinanisol separated by alkali. The quinanisol is further separated from the anisidine by means of the difficult solubility of the acid sulphate of the quinanisol. Quinanisol, $C_{10}H_9NO$, boiling-point 304—305°, is a light yellow oil, turning green and then reddish violet on standing. The salts of *p*-quinanisol have a blue fluorescence in aqueous solution, and give, like quinine, with chlorine water and ammonia, a green colouration or precipitate. With Sn and HCl, quinanisol gives tetrahydroquinanisol, $C_{10}H_{13}NO$, called "thalline." The hydrochloride is freed from quinanisol by recrystallisation from alcohol and alcohol ether. With bromine, it yields a yellow substance of the formula $C_{10}H_9Br_2NO$. The salts are good antipyretics, and are said to be especially useful in cases of yellow fever. With methyl iodide, three compounds are formed: the one is basic thallinehydriodide ($C_{10}H_{13}NO$), HI, the second dimethylthallinehydriodide, $C_{10}H_{12}NO(CH_3)_2I$, and the third is methylthalline. In this process, methylthalline is a by-product; whereas with ethyl iodide, ethylthalline is the principal compound formed. It forms hygroscopic salts. The hydrochloride has the formula $C_{10}H_{12}NOC_2H_5HCl$. From thalline and benzylchloride, benzylthalline has been prepared.

—J. B. C.

Is Hopeine identical with Morphine? Chem. Zeit. 10, 207 and 238.

OWING to Williamson's publication on the new alkaloid "hopeine" and its reactions, Ladenburg repeated the experiments of the former on a preparation sold under the name of hopeine, and made by the London Concentrated Produce Company. This preparation was compared with pure morphine, special attention being given to those reactions which were stated by Williamson as being characteristic of hopeine. These could not be obtained in any case, and Ladenburg therefore concludes that morphine and hopeine are identical substances. In reply to Ladenburg, Williamson states that from what he was able to learn, the Concentrated Produce Co. has never yet prepared hopeine by his method, but from lupuline, and the difference of his results from those of Ladenburg is undoubtedly due to the fact that hopeine prepared from lupuline contains an alkaloid which is identical with morphine, but contains only traces of the true hopeine. The two investigators have now taken steps to work on a common raw material, in order to elicit the truth.—S. H.

Iodoformium Aromatisatum. Krieger. Pharm. Zeit. 1885, 30, 744.

ALTHOUGH the iodoform manufactured by E. Schering, of Berlin, by means of electrolysis, possesses a more agreeable odour than the usual kinds found in commerce, it is nevertheless sufficiently unpleasant. To disguise the smell, the author adds a few drops of the ethereal oil of sassafras wood.—J. B. C.

The Extraction of the Alkaloids from Cinchona Bark. J. E. de Vrij. Pharm. Rundsch. 1885, 3, 225.

THE author finds that the total alkaloids may be extracted with dilute HCl, HNO_3 , or H_3PO_4 ; but incompletely with H_2SO_4 . HCl is found to give the best results. The amount of acid must be in the proportion of 4 molecules to 1 molecule of the total alkaloids, for which 310 may be taken as the molecular weight. To determine the quantity of alkaloids, 20grms. of the finely-powdered bark are digested with 180—200cc. of dilute HCl, and the extract precipitated with an excess of caustic soda. The precipitate is washed upon a double filter with water until the washings are colourless. The filtrate is measured, and owing to the solubility of the alkaloids, .0585grm. is added for every 100cc. of washings. The precipitate is dried between filter-paper, then at a gentle heat, and weighed until constant.—J. B. C.

The North American Aconite. Prof. Lloyd and C. G. Lloyd. Pharm. Rundsch. 1885, 3, 231.

OF the many kinds of aconite growing in the States, two species are of interest—viz., *A. uncinatum* and *A. Fischeri* Reichenbach. *A. uncinatum* grows on the banks of the mountain streams of the Alleghanies. The stem is 6—1.5m. high. It is identical with *A. ferox* of the Himalaya Mountains; but whereas this plant is rich in aconitine, the other contains only traces. *A. Fischeri* is the only American source of aconitine for medicinal purposes. This species grows on the mountains bordering the coast at a height of from 2500—3500m. The stem is 1—1.5m. high. The root resembles *A. napellus*.

—J. B. C.

The Solubility of Mercurous Iodide in Fats and other Bodies. C. Mchu. Journ. Pharm. Chim. 885, 5 Ser. 12, 249.

SWEET almond oil dissolves mercurous iodide in sufficient quantity for most therapeutic objects at 100°. 1000grms. oil dissolve 13grms. iodide, of which two-thirds separate on cooling; at 180° 1000grms. oil dissolve 80grms. Oil which contains 4grms. iodide to 1000 does not deposit any salt on cooling, so that 4 : 1000 is a practically reliable proportion. Potassium iodide increases the solubility. 1000grms. almond oil dissolve 50grms. Hg_2I_2 . KI. Olive oil behaves like almond oil. Poppy-seed oil takes up three times the quantity of iodide. Cocoa-nut oil dissolves 13grms. per 1000. Castor oil is one of the best solvents, and dissolves 20grms. Tallow dissolves 12.5grms. at 100°. Vaseline dissolves only 2grms. at 100°. Phenol dissolves 20grms. at 100°, of which more than half separates out on cooling. 1000grms. benzene take up 4grms. in the cold.

—J. B. C.

Note on Mercury Tannate. Ch. Casthelaz. Journ. Pharm. Chim. 1885, 5 Ser. 12, 352.

THE author recommends for the preparation of mercurous tannate the precipitation of mercurous acetate with tannin, whereby a pure compound is obtained. As the mercuric acetate is much more soluble than the mercurous salt, the latter is readily obtained pure. The salt is dissolved in warm water, with the addition of glucose, to reduce any trace of mercuric salt present, and the filtered solution at 50° is poured into a cold solution containing an excess of tannin. A grey precipitate forms, which is washed, pressed and dried at a low temperature. For the preparation of mercuric tannate, a dilute solution of mercuric nitrate may be used, or mercuric

acetate, or finally a solution of mercuric acetate, obtained by boiling mercuric nitrate with sodium acetate.

—J. B. C.

A New Constituent of the Atropa Belladonna. H. Kunz. Arch. Pharm. 1885, 23, 721.

(1.) IN addition to ordinary belladonna and hyoscyamus alkaloids, bilineurin or cholin occur, which are soluble in water. (2.) In the alkaline extract of belladonna, chrysotropic acid occurs, and it is to this substance that the fluorescence is due. This acid crystallises in light yellow prisms. (3.) In addition to the above acid, leucotropic acid occurs. This crystallises from ether in silky prisms. (4.) Belladonna extract contains also 6 per cent. of succinic acid.—J. B. C.

Improvements in the Manufacture of Acetate of Amyl. W. V. Wilson, colour manufacturer, Mile End, E. Eng. Pat. 4669, April 15, 1885. 4d.

THE claim is for mixing fusel oil with acetate of lime, treating with excess of hydrochloric acid and distilling over the acetate of amyl.—T.

Obtaining Granulated Antiseptic Preparations. W. Dalrymple Borland, Highbury. Eng. Pat. 12,985, October 28, 1885. 6d.

THE patentee avails himself of the intumescence of partially dehydrated borax to produce spongy granules by heating carefully. He charges these granules with various antiseptics.—T.

XXII.—GENERAL ANALYTICAL CHEMISTRY.

Improvements in and relating to Chemical or Analytical Balances. W. E. Heys, Manchester. From E. Becker, New York. Eng. Pat. 15,678, December 21, 1885. 6d.

THE inventor claims a new device for shifting a small balance weight, or rider, placed on the graduated upper surface of the beam of an analytical balance, by means of a rod which runs parallel with the scale beam, and is carried near its middle upon the scale column, whilst one end passes through and is supported by the glass case which encloses the balance. The rod can be shifted longitudinally as well as turned on its axis, and is provided with two fingers inside the case which deal with the rider weight as required. The patent also covers an improvement in the construction of the base of the case, with the view to adding to the rigidity of the whole.—B.

Estimation of Iron and Aluminium in the Presence of much Phosphoric Acid. Chem. Zeit. 10, 120.

THIS case chiefly occurs on analysing phosphates as used for the manufacture of artificial manure. After separating silica the solution is made up to 500cc. In 50cc. the phosphoric acid is determined by the molybdic method; in another 50cc. iron is estimated by titration with permanganate, and lastly a known quantity of ferric solution is added to 50cc. of the solution in order to precipitate by ammonia the whole of the phosphoric acid as ferric phosphate. After deducting from the weight of this precipitate in the dry state the amount of iron peroxide added, the rest will represent alumina, iron peroxide and total phosphoric acid; and subtracting from it the phosphoric acid and iron peroxide, previously estimated, the difference shows the amount of alumina.

—S. B.

Analysis of Manganese. C. Meineke. Chem. Zeit. 9, 1787.

A REPLY on the subject of Hampe's method for estimation of manganese with KClO_3 . The author finds that the results obtained by this method are in some cases too low.—J. B. C.

The Determination of Iron and Aluminium in Natural Phosphates. Chem. Zeit. 9, 1752.

WITH reference to a previous communication on this subject, which appeared in the above journal (*Chem. Zeit.* 9, 1050), Dr. Lucion has added the following information:—The method which was first proposed had the advantage of being independent of the insolubility of the phosphates of iron and aluminium in acetic acid. The method is briefly as follows:—The precipitate formed with ammonia is weighed, and from this the weight of the phosphoric acid and lime is deducted. The value for the lime is the difference between the total amount of lime and that remaining in the ammoniacal liquid. The objection may be raised to this method (in determining very small quantities) that one determination is dependent on three others. If the solution of the phosphate is precipitated with ammonia, and then oxidised with acetic acid, the whole of the lime cannot be eliminated by washing, even when boiling water and acetic acid are used, lime being retained by molecular adhesion. In order to free the precipitate of iron and aluminium phosphate completely from lime, the following precautions must be taken:—

1. The precipitation should be made in a very dilute solution ($\frac{1}{2}$ l.) 11. The precipitate is redissolved in hydrochloric acid, diluted, ammonia and acetic acid added, and filtered through the same paper used in the first operation. In this way a precipitate free from lime is obtained. The next operation is simple. It is generally supposed that alumina and iron form half of the precipitate, and this is correct when iron is in excess—not, however, when alumina preponderates. The phosphoric acid may be determined in the precipitate after heating, or in an equal part of the original liquid. Alumina and iron are then obtained by difference. If the iron alone is required, it is titrated with permanganate and 71 parts phosphoric acid are calculated for 80 of iron. The remainder is phosphate of alumina, from which the alumina may be calculated, as 122 aluminium phosphate give 51 alumina.—J. B. C.

Review of Indicators used in Volumetric Analysis. G. Lunge. Ber. 18, 3290—3291.

THE number of indicators introduced recently into alkalimetry has become largely extended, and increases steadily. Certain Institutes ignore this fact and continue to employ exclusively the apparently beatified litmus solution. This appears strange, because not only is litmus very much less sensitive than other indicators, but the boiling of the solution, as required in many cases, whereby the glass vessel is attacked and alkali dissolved, causes an addition to the errors of analysis. Many indicators which are not affected by CO_2 allow of titration in a cold solution. A series of indicators and their sensitiveness has been experimented upon by R. S. Thomson (*Chem. News*, 47, 123, 135, 184; 49, 32, 38, 119; 52, 18, 29). Thomson finds methyl orange to be one of the most sensitive and useful indicators for alkalis, mineral acids, etc. The objections formed against it are, in consequence of the solution having been too concentrated or the titration made in a hot solution, and also because instead of methyl orange one of Witt's tropcolines has probably been used. Fisher and Phillip have recently recommended the use of the nonsulphonated methyl orange or dimethylanidoazobenzene. The author does not find it as sensitive as methyl orange. These results have also been confirmed by R. J. Thomson. R. Engel and J. Ville have recently called attention to two new indicators, indigo-sulphonic acid and Poirrier's cotton blue C4L. The former only indicates the change of colour slowly, and is therefore useless; the latter gives a sharp indication, but unfortunately the colour changes before the caustic alkali is neutralised.—J. B. C.

Proposed Scheme for the Detection of the Organic Colouring Matters. O. N. Witt. Chem. Ind. 9, 1—7.

THE number of artificial colouring matters used in the trade is very large, and the difficulty in distinguishing them is increased by the fact that the same colouring mat-

ter is sold under different names. The object of the present paper is to give a method for the qualitative analysis of some of the more important colouring matters. They are arranged according to the reactions which they give. Before analysing the dyestuff it is important to know whether it is a mixture or a single substance. This may be ascertained in the following way. Some of the powdered substance is spread on filter paper, and the latter is moistened on the under side with water or alcohol. The paper is stained in the case of a homogeneous substance with streaks of the same shade of colour. In other cases different shades will run side by side and may be readily detected. The difference is more readily observed in transmitted light. The approximate quantities in the mixture may also be estimated. This is, so far, of importance, as it may be necessary to distinguish actual mixtures from a colour made to a certain shade with a slight addition of another substance. In the latter case the colouring matter is practically homogeneous, and may be analysed accordingly. Among the azo-colours, mixtures of shades occur which are so similar, that the filter-paper method does not suffice for their detection. The fact that these azo-compounds dissolve in concentrated H_2SO_4 with characteristic shades may be here conveniently utilised. The powder is strewn on the surface of perfectly colourless sulphuric acid contained in a porcelain basin. The observer will see at once if the particles dissolve with the same colour. If, for example, the mixture be one of orange with croceine scarlet, carmine red streaks will form beside those of indigo blue. Mechanical mixtures occur most frequently. Sometimes mixtures are prepared by evaporating solutions of the different colouring matters. In this case the test of the dyeing power can only be employed, as the substances are too intimately associated to be detected by the above methods. This test is based upon the fact that in these mixtures one colouring matter has a greater affinity for the fibre than the others. A bath of the colour is prepared, and small silk or woollen skeins are successively dyed until the bath is exhausted. If a mixture is present the first and last skeins will possess distinct shades. For example, if the dyestuff consist of a mixture of green and violet, the wool first absorbs the violet, and leaves a green solution, which imparts all its colour to silk. Impurities in a homogeneous colour may also be detected by this method. These tests may be completed in a few minutes by using miniature apparatus. It is also important to determine the non-colouring constituents, such as common salt. The colour is in this case burnt and the chlorine determined in the ash. Amongst other adulterations, the following may be mentioned:—

1. *Sugar*.—On account of its high price this substance is not largely used. Sugar is occasionally coloured with magenta and mixed with that colour. Its crystalline form, taste, and the fact that the powdered crystal is white, afford ready means of detection.

2. *Dextrin* is easily recognised by its smell on dissolving the colour in boiling water. It is mostly used with rosaniline colours. The colouring matter may also be separated with alcohol, which leaves the dextrin undissolved. The dextrin may be determined quantitatively in this way.

3. *Common Salt* is exceptionally used for diluting cheap and soluble colours, as, for example, Bismarck brown. Alcoholic extraction of the colouring matter may be here employed.

4. *Glauber's Salt* is *par excellence* the diluent for all azo-colours. Its detection may be effected by dissolving the colour in water, precipitating with an excess of pure sodium chloride, filtering off from the precipitate, and testing the sulphuric acid in the filtrate. This method gives approximately quantitative results. To obtain exact quantities, the precipitate with sodium chloride must be washed on the filter with solution of common salt until free from H_2SO_4 .

5. *Magnesium Sulphate* is occasionally employed in place of the above, and may be detected by a similar method.

It is sometimes of interest to the dyer, and especially to the printer, to know, in the case of a basic

colour, with which acid it is combined. In most cases it is the hydrochloride, but exceptions are not unfrequent. The base is precipitated with ammonia, and the acid tested for in the filtrate. In some cases, as, e.g., safranin, this method cannot be employed. The test must then be effected in the solution of the colour itself. Double zinc chloride salts leave an ash on heating, which may be tested for zinc. As in the case of a basic colour, the acid is tested for, so, in that of an acid colouring matter, the base may be detected. The substance is dissolved in water, the acid precipitated with pure concentrated HCl ; the base is found in the filtrate. In the case of ammonia, it suffices to warm the substance with caustic soda. The colouring matters in the following list are grouped according to the shade which they impart to woollen fibre. A preliminary test must in every case be made, and according to the result the colour will come under one of the groups.

Apparatus and Reagents for Analysis.

In addition to a large test tube, which may be used as a colour bath, the following will be found useful:—

1. A number of clear white porcelain basins or watch glasses placed on a white surface.
2. A number of good test tubes.
3. Funnels and filter papers.
4. A lamp.
5. A pocket spectroscope which gives the Fraunhofer lines distinctly.
6. A pocket microscope.

The following reagents:—Distilled water, pure colourless sulphuric acid, hydrochloric acid, ammonia, zinc dust, and the usual qualitative reagents.

A.—RED COLOURS.

I. *The colour is insoluble in cold and hot water, easily soluble in alcohol.*

a. The alcoholic solution is salmon-red, without fluorescence. The solution in concentrated H_2SO_4 is red violet.—*Carminaphtha*.

b. This colour, not widely known, is manufactured by Durand and Huguenin, of Basel, and finds a limited application in calico printing. The alcoholic solution is bluish-red and gives an intense orange-red fluorescence. It gives a broad absorption band with the spectroscope, which extinguishes the yellow and the green. The solution in concentrated H_2SO_4 is green-grey. On diluting with water it is coloured red, and a violet-red precipitate forms.—*Magdala Red*.

c. Insoluble in cold water, soluble in hot. Its behaviour in alcoholic solution is similar to that of Magdala red, but it gives an absorption band lying more to the right, so that a portion of the yellow is visible. The solution in concentrated H_2SO_4 is colourless; on diluting, each drop of water produces a red tint, which disappears on shaking, until the dilution reaches a certain point, when the liquid becomes of a magenta tint.—*Quinoline Red*.

d. The alcoholic solution is fluorescent, but the fluorescence is greener. The solution in sulphuric acid is lemon yellow to orange, and does not give on dilution any characteristic change of colour.—*Spirit Eosine*.

e. The alcoholic solution is a dusky bluish-red. The solution in H_2SO_4 is green, on dilution blue-red.—*Rhodindine* (induline of the naphthalene series).

II. *The colour is more or less soluble in cold water, readily in boiling water.*

a. *Basic Colours* (precipitated with caustic soda).

a. The aqueous solution is blue-red; on the addition of HCl or H_2SO_4 it becomes yellowish-brown. Sodium acetate reproduces the red colour. In a dilute solution, which is faint red, on the addition of ammonia, wool is coloured an intense red. Zinc dust decolorises the aqueous solution, and the colour cannot be restored. The solid product consists either of distinct green crystals, or a metallic green powder which dissolves in H_2SO_4 with a yellow-brown colour.—*Fuchsin* (rubin, magenta, aniline red).

b. Blue red solution. Ammonia forms a flocculent orange precipitate, extractible by ether, giving a yellow fluorescence. Solution in concentrated H_2SO_4 green, on dilution changing from blue and violet to red.—*Toluylene Red* (neutral red, generally very impure; the reactions, therefore, are not distinct).

β. Acid Colours or Basic Colours of the Saffranine Group (not precipitated with caustic soda).

a. On addition of NaOH to the aqueous solution a change of colour is produced; the liquid is coloured blue. Solution in H_2SO_4 brownish-yellow, on dilution turning redder.—*Galleine*.

b. The aqueous solution gives, on addition of alcohol, a distinct grey-yellow fluorescence. Addition of acid produces no precipitate. Zinc dust decolourises, but in presence of air the original colour is restored. Solution in H_2SO_4 green, on dilution changing to blue and then to red.—*Saffranine* and *Saffranisol* (identified by the shade on dyeing).

c. The aqueous solution is a pure red, and gives a greenish-yellow fluorescence, which is more pronounced on dilution. The addition of acid gives a yellow flocculent precipitate, soluble in ether. The ethereal solution is pure yellow, without fluorescence. Solution in H_2SO_4 yellow.—*Eosin*.

d. The aqueous solution is of a bluer red, and gives no fluorescence. Acids give a straw-yellow precipitate, which dissolves in ether with the same colour. Solution in H_2SO_4 golden yellow. Zinc dust in the ammoniacal solution decolourises. When this solution is dropped on to filter paper it is immediately coloured intense blue-red. (Distinction from Eosin).—*Eosin Scarlet* (bromo-nitro fluorescein).

e. Solution blue-red without fluorescence. Acids give a yellow precipitate, soluble in ether. Solution in H_2SO_4 orange-yellow. Zinc dust and ammonia decolourise, and the solution becomes in air only very faintly coloured.—*Phloxin*, *Rose Bengal* (distinguished by difference in shade).

f. The concentrated hot aqueous solution solidifies to a jelly on cooling. Acids produce a brown, flocculent precipitate. On warming with zinc dust and ammonia, the solution changes to yellow, and eventually becomes colourless. The solution in H_2SO_4 is grass-green. On dilution it changes to blue, and then a dirty brown precipitate forms.—*Biebrich Scarlet* (double scarlet).

g. Barium chloride added to the aqueous solution gives a flocculent red precipitate, which, on boiling, becomes crystalline, and simultaneously dark violet. Solution in H_2SO_4 is indigo blue, changing on dilution to violet and red.—*Croceine Scarlet*, *βB*.

h. The aqueous solution, with the slightest trace of acid, is coloured pure blue. It colours cotton in aqueous solution fast red. Solution in H_2SO_4 slate blue, not changing on dilution.—*Congo Red*.

i. The aqueous solution solidifies on cooling with the separation of brilliant bronze-coloured crystals. Solution in H_2SO_4 violet, on dilution a brown precipitate forms.—*Xylidine Ponceau* (from α-naphthol sulphonic acid, D.P. 26,012).

j. Magnesium sulphate, added to the concentrated aqueous solution, forms, on cooling, long silky needles of the magnesium salt. Solution in H_2SO_4 violet. Wool is dyed bright scarlet.—*Croceine Scarlet*, *βB extra* (from diazo-naphthionie acid and croceine-β-naphthol-sulphonic acid).

k. The aqueous solution produces, on addition of calcium chloride and barium chloride, an amorphous flocculent precipitate. Solution in H_2SO_4 is rose or carmine, forming, on dilution, a brown red precipitate.

Colouring matters from β-naphthol disulphonic acid are distinguishable by their different shades on dyeing.—*Ponceau R*, *2R*, *3R*, *Anisol Red* *Coccine* (D.P. 32291).

l. Wool is dyed magenta. In the aqueous solution, calcium chloride produces a red semi-crystalline precipitate. Solution in H_2SO_4 blue-violet, changing on dilution to red.—*Acid-azorubin* (D.P. 26,012).

m. A deep brownish-red solution, which dyes wool the same colour. The solution in H_2SO_4 blue, on dilution a yellowish-brown precipitate is formed.

The concentrated boiling aqueous solution gives, on the addition of a drop of saturated solution of soda, a crystalline precipitate of the sodium salt in the form of brown scales.—*Fast Red* (*Rocellin*).

n. Aqueous solution, Bordeaux red. A flocculent amorphous precipitate with calcium and barium chloride. Solution in H_2SO_4 indigo blue.—*Bordeaux B*, (D.P. 3229).

o. Aqueous solution, blue red, which is decolourised with NaOH. Acetic acid restores the original colour.—*Acid Magenta*.

B.—YELLOW AND ORANGE COLOURS.

I. The colour is insoluble in cold water, nearly or quite insoluble in hot water, soluble in alcohol.

a. Solution in lemon yellow, alkalis and acids produce a slightly deeper tint.—*Phthalogluconine*.

b. The solution is golden yellow. Acids produce not change. Alkalis and boric acid change the colour to a deep reddish brown.—*Turmeric*.

c. The solution is golden yellow. The addition of HCl produces a red colouration. Amyl nitrite has no action on boiling.—*Dimethylglutidazobenzene*.

d. Same as for *c*, but amyl nitrite decolourises and produces an evolution of nitrogen.—*Amidazobenzene*.

II. The colour soluble in cold, very soluble in hot water. Soluble in conc. H_2SO_4 without a deep colouration.

a. Caustic soda produces no precipitation.—*Acid Colours*.

a. A greenish yellow solution with a bitter taste. Alkalis change it to dark yellow. Acids have no action.—*Picric Acid*.

b. Golden yellow solution. Acids produce a white precipitate.—*Martius Yellow*.

c. Golden yellow solution, not precipitated by acids. KCl produces crystallisation in fine needles.—*Acid Naphthol Yellow*.

d. The solution is brown yellow, and has a green fluorescence, which disappears with acids, a precipitate being at the same time formed.—*Fluorescein* (Uranine) *Benzylfluorescein* (Chrysolin).

In order to distinguish these two colours, a more exact investigation of the separated acids is necessary.

e. Solution is golden yellow, not precipitated by acids. It is not decolourised by zinc dust and ammonia, or tin salt and HCl.—*Quinoline Yellow*.

β. Caustic soda produces a precipitate.—*Basic Colours*.

a. Yellow precipitate with alkalis, soluble in ether, with a yellow colour and green fluorescence.—*Phosphine*.

b. Milk-white precipitate with alkalis, soluble in ether to a colourless solution, with a greenish blue fluorescence.—*Flavraniline*.

c. Milk-white precipitate with alkalis, soluble without colouration, and without fluorescence in ether. The yellow solution boiled with HCl is gradually decolourised.—*Auramine*.

III. The colour is soluble in water. The H_2SO_4 solution is strongly coloured.—*Azo Colours*.

a. Caustic soda produces no precipitate.

a. The colour on wool is yellow. The aqueous solution solidifies, on cooling, to a blood-red jelly. Solution in H_2SO_4 brownish yellow.—*Chrysoidine*.

b. The colour on wool is orange brown. The solution does not gelatinise on cooling. Solution in H_2SO_4 brown.—*Icesuvin* (Bismark brown, Phenylene brown).

β. Caustic soda produces no precipitate.

a. Solution in H_2SO_4 yellow; on dilution, salmon red. Solution in water yellow.—*Fast Yellow*.

b. Solution in H_2SO_4 yellow; on dilution, carmine red. Solution in water, yellow, which crystallises on

cooling in golden plates. Dilute acids produce a reddish violet precipitate.—*Methyl Orange*, *Ethyl Orange*.

c. Solution in H_2SO_4 violet; on dilution, red violet, with the simultaneous formation of a steel-grey precipitate. Solution in water, yellow, which on cooling crystallises. Chloride of calcium and barium form insoluble precipitates.—*Tropaeolin OO*, *Diphenylamine Yellow*.

d. Solution in H_2SO_4 bluish green; on dilution, violet, with formation of a steel-blue precipitate. Solution in water, yellow, and crystallises on cooling. Barium chloride forms a yellow salt, which crystallises from a large quantity of water in plates.—*Yellow N* (Poirrier).

e. Solution in H_2SO_4 yellowish green; on dilution, violet, with a grey precipitate. Solution in water, yellow, crystallising on cooling. Calcium chloride produces an orange precipitate, which on boiling changes to red, and becomes crystalline.—*Leucoline*.

f. Solution in H_2SO_4 carmine red; on dilution, yellow. Solution in water, yellow; often cloudy; turning red to violet with alcoholic caustic soda.—*Citronine* (Indian yellow, Curcumin).

g. Solution in H_2SO_4 deep orange; no change on dilution. Aqueous solution, orange; on addition of calcium chloride crystalline calcium salt.—*Orange G* (D.P. 3229).

h. Solution in H_2SO_4 brown-orange; no change on dilution. Aqueous solution, yellow. Addition of little HCl produces crystallisation in yellow plates; addition of much HCl separates the free acid in grey needles.—*Tropaeolin O* (Chrysoin).

i. Solution in H_2SO_4 carmine red; on dilution, orange. Aqueous solution, reddish orange. Calcium chloride precipitates the red calcium salt, which crystallises from boiling water, in needles.—*Orange II*. (β -naphthol-orange mandarine).

j. Solution in H_2SO_4 violet; on dilution, orange. Solution in water red-orange, which, on the addition of NaOH , changes to carmine-red.—*Tropaeolin OOO* (Orange I).

C.—GREEN COLOURS.

a. Slightly soluble in water, with an olive brown colour. Alkalis effect complete solution with a grass-green colour. H_2SO_4 solution, dirty-brown.—*Caraleine*.

b. Readily soluble in water, with a green colour. Alkalis produce a rose-coloured or grey precipitate. Strong acids, a yellow colouration.—*Victoria Green*, *Brilliant Green* (may be distinguished by their different shades on dyeing).

c. Readily soluble in water, with a bluish-green colour. Acids colour it yellow; alkalis decolourise the solution without precipitation. A coloured sample is turned violet above 100° .—*Iodine* and *Methyl Green*.

d. Readily soluble in water, with a faint-green colouration. Acids increase the intensity; by a further addition the yellow colour is produced. Alkalis decolourise completely. Silk and bleached wool can only be dyed in an acid bath. (Methyl green also in a neutral bath.) Dyed samples may be heated to 150° without change.—*Sulphonic Acids of Benzaldehyde Green* (acid green, Heiveta green, and light-green S).

D.—BLUE COLOURS.

a. Insoluble in water. The alcoholic solution is coloured blue of different shades. HCl does not modify the colour, but precipitates microscopic green crystals. NaOH produces a brownish-red colouration. Conc. H_2SO_4 dissolves it with a light reddish-brown colour.—*Rosanine* and *Diphenylamine Blue* (distinguishable by the dyed silk samples, better by gas-light).

b. Insoluble in water; the alcoholic solution is coloured red with HCl . Alkalis have no action.—*Indophenol*.

c. Readily soluble in water. HCl produces a green, NaOH a violet-red precipitate. Zinc-dust decolourises. The colour is restored by the action of the air. It contains zinc.—*Methylene Blue*.

d. Soluble in water. Acids colour it yellowish-brown. Alkalis produce a reddish-brown precipitate.—*Victoria Blue*.

e. Easily soluble in water. Alkalis produce decolourisation. Wool absorbs the colouring matter from the alkaline solution, and is coloured deep-blue on immersion in dilute acids.—*Alkali Blue*, *R-6B* (distinguished by their shades).

f. Easily soluble in water; dyes only in an acid-bath. Zinc-dust and ammonia form a colourless dye bath, as in the case of indigo. Dilute nitric acid, on boiling, destroys the colour.—*Indigoearmine*.

g. Insoluble in water; soluble in alcohol. Alkalis colour the alcoholic solution, brown-red to violet. Conc. H_2SO_4 forms a blue solution. *Induline*, *R-6B* (the solubility increases with the redness of the shade).

h. Soluble in water. Acids produce a blue precipitation; alkalis a red to violet colouration. Zinc dust and ammonia produce a colourless dye-bath; dilute nitric acid, on warming, does not decolourise.—*Soluble Indulines* (distinguished by their shades).

i. The commercial product is a grey paste. NaOH produces, in presence of air, an immediate blue colour.—*Leucoindophenol*.

j. The commercial product is a grey paste, which dissolves in NaOH without a blue colouration. The addition of grape sugar and (on warming) indigo-blue, separates in crystals.—*o-Nitrophenylpropiolic Acid*.

E.—VIOLET COLOURS.

a. Scarcely soluble in water; soluble in alcohol. The solution in H_2SO_4 has a cinnamon-brown colour.—*Diphenylrosaniline* (regina purple).

b. Soluble in water. Alkalis give a precipitate, HCl colours the solution first green, then yellow.—*Methyl Violet*, *R-6B*, *Hofmann's Violet* (distinguished by their shades).

c. Not very soluble in water. Alkalis produce a violet precipitate. Conc. H_2SO_4 dissolves it with a grey colour. On dilution the solution changes successively to grey-green, light-blue, bluish-violet, and lastly reddish-violet.—*Mauveine* (Perkin's violet).

d. Soluble in water. Acids precipitate a blue, alkalis a reddish-violet substance. With zinc-dust in acid and in ammoniacal solutions, it forms a reduced dye-bath. Solution in conc. H_2SO_4 emerald-green; on dilution, light-blue.—*Lanth's Violet* (thionin).

e. Soluble in boiling water. HCl colours it pure carmine. Conc. H_2SO_4 produces a blue; on dilution, a red colour.—*Gallocyanine*.

f. Soluble in water, with a reddish-violet colour. On addition of alcohol it gives a carmine-red fluorescence. Conc. H_2SO_4 dissolves it with an emerald-green colour. On dilution the liquid becomes blue or violet.—*Amethyst*, *Fuchsine*, *Girofle* (violet safranin colours, with ethylated nitrogen and methylated homologues of phenosafranin).

Those colours which are omitted in the above list will be considered by the author in a future paper.—J. B. C.

Characteristic Reaction of Vanillin. F. Tiemann. Ber. 18, 3493—3496.

It is known that aqueous solutions of vanillin assume a bluish violet colouration with ferric chloride. It is here shown that on heating the solution, *dehydrodivanillin*, $\text{C}_{12}\text{H}_4(\text{OH})_2(\text{COH})_2(\text{OCH}_3)_2$, separates from the liquid in fine white needles sparingly soluble in water, alcohol, ether, benzene and chloroform, but readily soluble in alkalis. The pure substance melts at $303\text{--}304^\circ$, and is derived from two molecules of vanillin by the abstraction of two atoms of hydrogen. Its formation is analogous to that of dihydymol from thymol, cedriret from ethyldimethylpyrogallol ether, and of indigo from indoxyl by means of the same reaction. When dehydrodivanillin is heated with sodium methylate and methyl iodide,

dimethyldehydrodivanillin, $C_{12}H_4(CO)_2(OCH_3)_4$, is obtained. It crystallises in white needles melting at $137-138^\circ$, is insoluble in water and alkalis, but more soluble than dehydrodivanillin in alcohol and ether. When dehydrodivanillin is fused with caustic potash it is converted into *dehydrodiprotocatechuic acid* $C_{12}H_4(OH)_4(COOH)_2$. After fusion the melt is dissolved in water, and the acid liberated by the addition of hydrochloric acid. It is purified by conversion into the calcium salt, which is subsequently decomposed by hydrochloric acid. An amorphous flocculent precipitate is obtained, which on drying melts at above 300° . This compound is slightly soluble in water, and more soluble in alcohol. With ferric chloride it gives the characteristic colour reactions of protocatechuic acid, with copper sulphate a brownish red, with silver nitrate a brown, with lead acetate a white, and with zinc sulphate a white precipitate. The salts of the alkalis and alkaline earths with this acid are soluble in water. The author concludes from these observations, and especially from the formation of dehydrodiprotocatechuic acid, that the compounds described by him are probably derivatives of diphenyl.—D. B.

Monthly Patent List.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

- 4012 O. Klauwig, Halifax. Improvements in apparatus for steaming and drying solutions and other substances. Complete specification. March 23
- 4015 O. H. Castle, London. Improvements in machines for manufacturing ice. Complete specification. March 23
- 4017 A. B. Frenzel, London. Improvements in vacuum pans. Complete specification. March 23
- 4096 J. Laidlaw and A. J. Liversedge, Glasgow. Improvements in the construction of centrifugal machines, otherwise known as hydro-extractors. Complete specification. March 24
- 4159 J. R. Alsing, London. An improved triturating cylinder. Complete specification. March 24
- 4161 A. Laing, London. Apparatus for ventilating stoke holes and supplying boiler fires with heated air. Complete specification. March 24
- 4217 B. H. Thwaite, Liverpool. An improved gas generator and boiler furnace. March 26
- 4267 J. Lockhart, Sheffield. Improvements in heating apparatus. March 26
- 4314 A. H. Smith, London. An improved injector for steam boiler and other furnaces. March 27
- 4422 W. A. Entwistle and P. Smith, Manchester. Improvements in lubricating and protecting from injury the leathers of all kinds which surround the rams of all kinds of hydraulic presses, accumulators, pumps, and all other machinery where leathers of all kinds are subjected to pressure or friction. March 30
- 4429 L. A. Groth, London—Communicated by A. Traub, France. A new or improved auxiliary heater for boilers, furnaces, etc. March 30
- 4430 L. A. Groth, London—Communicated by A. E. Barthel, United States. A new or improved furnace grate. Complete specification. March 30
- 4497 T. W. Beverley, Sheffield. Improvements in blowing apparatus. March 31
- 4518 M. Reuland, London. Improvements in drying apparatus. March 31
- 4601 B. D. Healey, Liverpool. Improvements in gas-fired furnaces for various purposes. April 2
- 4609 T. G. Hardie, Burnley. The combustion and destruction of town refuse and other matter, also as a crematory,—a special form of furnace. April 2
- 4656 J. S. Sawrey, London. Improvements in filters. Complete specification. April 2
- 4700 E. N. Henwood, London. Improvements in the construction and arrangement of furnaces and appliances therefor, where hydrocarbon oil in conjunction with compressed air or steam are used as fuel. April 3
- 4736 H. E. Newton, London—Communicated by M. Hanmore, R. Van Selons Mattison, and H. G. Keasbey, United States. An improved non-conducting covering and composition for pipes or tubes and other vessels or receptacles. Complete specification. April 5
- 4773 G. Fry, London. Improved apparatus for preventing the bulging of linings of boilers or other vessels employed in oiling under pressure. April 6
- 4869 D. Hancock, D. C. Hancock, and A. H. Hancock, Stratford. Improvements in the construction of valves for hot and cold water and other fluids. April 7
- 4871 G. F. Redfern, London—Communicated by M. H. Simonet, France. An improved grinding and triturating

- 4991 A. J. Bell, Manchester. Improvements in filters. April 10
- 5032 A. M. Clark, London—Communicated by H. F. L. Worms de Romilly, France. An improved method of and apparatus for raising and forcing liquids, exhausting air and gases, blowing, boiler feeding, and other purposes. April 10
- 5251 C. E. Davis, London. Improvements in apparatus for mixing liquids. April 15
- 5292 C. Brader, Manchester. An improved covering for steam or hot water pipes, cylinders and boilers, and improved apparatus for preparing the same. Complete specification. April 16
- 5325 C. Wickstead, London. Improvements in tubes applicable to boilers, condensers, and the like. April 16
- 5310 J. R. Alsing, London. Improvements in the construction of triturating cylinders. Complete specification. April 16
- 5313 C. E. Gittens, London. Improvements in filters. April 16

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 4889 F. Maxwell-Lyte. Crucibles, muffles, and other refractory apparatus. April 20
- 6066 W. Weldon—Communicated by A. R. Peehiney et Cie. Apparatus for cooling gases and vapours. April 2
- 6173 H. H. Lake—Communicated by E. Friedrich. Improvements in engines or boilers in which steam or a mixture of steam and hydrocarbon vapours is employed. March 26
- 6676 W. S. Boulton. Apparatus for "washing" or separating. March 26
- 7012 J. Engelson. Steam generators. April 2
- 7194 B. J. B. Mills—Communicated by C. Diener and C. A. Mayrhofer. Electro-hydraulic vacuum apparatus. April 16
- 7237 J. Imray—Communicated by La Compagnie de Five-Lille. Continuously acting centrifugal apparatus. April 16
- 7618 S. H. Johnson and C. C. Hutchinson. Improvements in filter presses. April 9
- 7677 H. Thompson. Furnaces for steam boilers and other purposes. April 6
- 7964 H. H. Lake—Communicated by F. J. Oakes. Evaporating apparatus. April 2
- 8031 H. Caswell. Improvements in and relating to furnaces. April 20

1886.

- 2168 G. Behrens. Filtering apparatus. March 26
- 2182 F. Grosvenor. Filters or water purifiers. March 26
- 2330 H. Davey. An improvement in steam generators. April 2
- 3190 J. B. Alliot and G. P. Houghton. Improvements in centrifugal drying machines. April 6
- 3559 H. E. Newton—Communicated by A. Chesebrough. Improvements in hot-air furnaces.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

- 4016 W. P. Thompson, Liverpool—Communicated by A. J. Ambler, United States. Improvements in apparatus for the production and utilisation of vapour fuel. Complete specification. March 23
- 4099 A. Dempster, Elland. A new or improved apparatus for purifying and enriching coal gas. Complete specification. March 24
- 4135 F. Mörth, London. Improvements in means or apparatus for supplying liquid or gaseous fuel to furnaces or fireplaces. March 24
- 4137 T. F. Veasey, London. Utilising waste heat given off from chimneys or furnaces. March 24
- 4163 A. Thomas, West Cowes. Regulating the flow of gas tar to be used as fuel in gas and other works, to be called "Tar fire regulator." March 25
- 4181 C. Holy, London. Improvements in circular or round burners for burning petroleum or similar fluids. Complete specification. March 25
- 4206 E. Brook, London. Improvements in apparatus for making gas. March 25
- 4220 M. P. Watt Boulton, London. Improvements in the application of heat to generating and heating steam. March 25
- 4250 T. Toward, W. Toward, and J. Meek, Newcastle-on-Tyne. Improvements in the production of forced draught and its application to steam-boiler and other furnaces for burning small coal and coal dust. March 26
- 4319 W. von Ruckteschell, London. A new combustible compound. December 16, 1885; previously included in No. 15175 of 1885.
- 4451 G. King, Becton. Improvements in fastenings for retort lids. March 30
- 4469 B. Loomis, London. Improvements in processes of and apparatus for manufacturing gas. Complete specification. March 30

The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Specifications thus advertised are open to inspection at the Patent Office immediately and to opposition within two months of the said dates.

- 1498 K. Proctor and F. C. Bell, London. An improved means of and apparatus for hermetically sealing the mouth-pieces, doors, covers, and lids of gas retorts. March 31
- 1582 W. A. Barlow, London—Communicated by J. F. W. A. Jahnke, Germany. Improvements in lamps and lanterns for burning carburetted coal gas. April 1
- 1614 C. C. Marley, Middlesbrough. Improvement in marine boilers by utilising heated gases hitherto wasted. April 2
- 1617 J. Dillamore, London. A new or improved apparatus for removing tar from the hydraulic mains used in the manufacture of coal gas. April 2
- 1711 W. Hibbert, Barnsley. Reflecting gas light and heat radiator. April 5
- 1769 J. Laycock and J. Baldwin, Keighley. Steam tar injector and tar burner. April 6
- 1785 R. Hutchinson, London. Improved apparatus for the application of the thermodynamic energy of petroleum and similar combustible fluids to the propulsion of locomotives, tram-cars, torpedo and other boats or vessels, and to the driving of stationary, portable, and other engines. April 6
- 5021 H. H. Lake, London—Communicated by L. Cline, United States. An improved artificial fuel. Complete specification. April 10
- 5118 H. Johnson, Dudley. Improvements in application of gas. April 13
- 5207 H. Bumby and N. L. Wieputte, Liverpool. Improvements in or relating to the utilisation of coke dust or refuse. April 14
- 5311 J. A. Drake, Halifax. An improved construction of apparatus employed for heating gas retorts. April 16
- 5348 W. W. Box, Westminster. Improvements in gas retort lids and fastenings. April 16
- 5412 H. Hawkins, Westminster. Improvements in gas retort lids, cross bars, and appliances for tightening the said lids. April 19

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 1023 C. J. Ball. Expanding gases and vapourising fluids by direct intermixture and molecular contact with heated gases. March 30
- 6059 J. McNair. Furnaces of retort chambers used in gas manufacture, and means for supplying heated air thereto. March 30
- 6257 C. D. Abel—Communicated by F. A. M. Alavoine. Hydraulic mains for gas-works. March 30
- 6931 A. Gontard. Purification of air or gases from solid or gaseous impurities, and apparatus therefor. March 30
- 6971 N. Frere—Communicated by A. Eln and E. Courcelles. System of heating by electricity. April 13
- 7212 G. G. M. Hardingham—Communicated by J. Grouvelle. Means for distributing heat by radiation. March 26
- 7358 A. M. Chambers and T. Smith. Improvements in coke ovens, and in methods and apparatus for collecting the products of combustion therefrom. April 20
- 7701 J. Y. Johnson—Communicated by C. Goublier. Manufacture of candles. April 6
- 7791 S. Butler. Apparatus for mixing and heating materials for manufacture of patent fuel. April 9
- 7805 J. Platt. Means for heating the air supply to furnaces for metallurgical and other purposes. April 20
- 8178 E. Green. Fuel economisers. April 20
- 9650 H. E. H. Wallis and H. T. Ratcliffe. Carburetted apparatus for burning coal gas with hydrocarbons. April 13
- 15286 C. A. von Welsbach. An illuminant appliance for gas and other burners. March 30
- 16080 E. Johnson. Improvements in open grates and stoves for saving of fuel and consumption of smoke. March 30

1886.

- 2950 J. Parkes. Apparatus for enriching illuminating gas. April 13

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, ETC.

APPLICATIONS.

- 4094 W. M. Fraser, Glasgow. Improvements in apparatus and arrangements for distilling mineral oils. Complete specification. March 24
- 1713 J. C. Mewburn, London—Communicated by La Société A. Renard et Duron, France. A process of and apparatus for treating colophony and other resinous substances to obtain benzene, toluene, xylene, and other products. April 5

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

- 1387 H. H. Lake, London—Communicated by A. Leonhardt & Co., through Wirth & Co., Germany. Improvements in and relating to the manufacture of colouring matters. March 29
- 1687 T. Maxwell and J. Young, Glasgow. Improvements in the manufacture of colouring matter. April 3
- 1711 J. C. Mewburn, London—Communicated by La Société A. Collincau et Cie., France. The production of black, violet,

and other dyes or colours by means of benzyaniline or its homologues, and the application thereof to vegetable and animal materials. April 5

3333 G. Epstein, London. Improvement in obtaining albumen and colour or dye.

COMPLETE SPECIFICATION ACCEPTED.

1885.

- 9214 M. Hoffmann and A. Weinberg. Production of new azo-colours. April 16

V.—TEXTILES: COTTON, WOOL, SILK, ETC.

APPLICATIONS.

- 4174 N. M. Bateson, London. An improved apparatus for ascertaining the percentage of sand or other foreign substances in raw cotton and other fibre. March 25
- 1323 B. Fiegel, London. An improved isolation process for the preparation of fibrous spun or woven material of all kinds. Complete specification. March 27
- 1471 H. H. Lake, London—Communicated by J. T. Waring, United States. Improvements relating to the preparation of animal fibres for felting. Complete specification. March 30
- 1780 E. Tweedy, H. L. Brevoort, and J. L. Roberts, London. Improved processes for preparing fur for felting. Complete specification. April 6
- 1781 E. Tweedy, H. L. Brevoort, and J. L. Roberts, London. Improved processes for preparing fur for felting. Complete specification. April 6
- 5111 H. Brummer, London. A new or improved fibrous material, and methods for manufacturing the same. April 19

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

- 1389 J. Y. Johnson, London—Communicated by N. Lecomte, France. Improvements in dyeing and bleaching cotton or other fibrous materials, and in apparatus connected therewith. March 29
- 1839 W. Birch, Manchester. Improvements in apparatus for washing, soaping, dyeing, and dunging woven fabrics. April 7
- 5113 M. Oldroyd and J. W. Hepworth, Halifax. Improvements in "Oldroyd's" burl dyeing machines. Complete specification. April 13

COMPLETE SPECIFICATION ACCEPTED.

1885.

- 7187 J. C. Mewburn—Communicated by G. Lombard et Cie. Purifying, bleaching, dyeing, etc., yarns or threads. March 30

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

- 1070 E. Arthur and E. M. Arthur, London. An improved process for obtaining crystallised sulphate of calcium. March 23
- 1388 T. Capper, London—Communicated by S. Pick, Austria. Improvements in apparatus used in the manufacture of ammonia soda. March 29
- 4737 G. J. C. M. Baron de Liebhafner, London. New caustic powders for the removal of paint and other deposits. April 5
- 1712 H. L. Pattinson, jun., London. Treating tersulphides or polysulphides of barium and strontium so as to recover the barium and strontium and obtain other products. April 5
- 1922 C. F. Claus, South Wimbledon. Improvements in the manufacture of carbonate of soda and of carbonate of potash, and in the treatment of residual products obtained in such manufacture. April 8
- 5016 J. H. Johnson, London—Communicated by J. L. Kessler, France. Improved process or means for expelling sulphuric acid in excess from sulphates and bisulphates. April 10
- 5031 N. B. Fowler, London. An improved process of treating phosphatic earths and rocks. April 10
- 5170 J. Mactear, Glasgow. Improvements in the manufacture of hydrates of strontia and of baryta. Complete specification. April 14
- 5255 A. Chantreux and I. Farinaux, Liverpool. A new or improved apparatus applicable for use in causticising alkaline lyes, dissolving chloride of lime, and the like. April 15
- 5326 T. Twynam, London. Improvements in the production of alkaline carbonates and hydrates. April 16

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 5388 H. B. Condy. Manufacture of hyposulphates and sulphates of alkalis. March 30

6866 T. Twynam. Production of soluble phosphates of the alkalis in the manufacture of steel and iron. April 6
 6867 T. Twynam. Production of alkaline phosphates in the manufacture of iron or steel from phosphoric pig iron. April 2
 7136 E. F. Trachsell. Producing hydrate or carbonate of strontium or of barium. April 9

1886.

1861 G. H. Nichols, W. H. Nichols, and J. B. F. Herreshoff. An improved sulphuric acid tower. March 26
 2233 M. R. Pryor and A. C. Jamieson. Extraction of nitrate of soda and other salts. March 30

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

4282 T. Ide, London. Improvements in moulds for bending plate and sheet glass. March 26
 1325 H. Norris, London. Colouring glass, porcelain, china, and other like substances to imitate stained glass, and for mounting same or not with leaden, metal, wood, or paper borders for decorative purposes, intended to be called "Acme vitre." March 27
 4509 J. G. Sowerby, London. An improvement in the fire polishing of glassware. March 31
 1887 S. G. L. Giles and W. J. Petrie, London. Improvements in the method of decorating Lincrusta-Walton, Tynecastle tapestry, calicorium, and other similar embossed materials employed for the decoration of walls and other surfaces. April 7
 5157 J. Laur, London; and W. Walker, Liverpool. Improvements in the ornamenting of glass, and applying it to the covering of walls, ceilings, and other architectural purposes. April 11
 5213 W. B. Fitch, London. Improvements in the manufacture of glass bottles, and apparatus therefor. April 11
 5291 D. Rylands and H. Lindsay-Bucknall, Barnsley. Improvements in glass smelting furnaces. April 16

COMPLETE SPECIFICATION ACCEPTED.

1885.

7100 W. R. Readwin. Hacking or grounding glass by working or blending powdered metals thereon, and imparting a metallic lustre thereto. March 30

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

4215 J. Brierley, Halifax. Improvements in floors of wood and earthenware combined. March 26
 4281 W. Hollier, London. Improvements in brick-moulding machines. Complete specification. March 26
 4330 G. H. Couch, London. Improvements in and applicable to brick, stone, terra-cotta, concrete, or other walls. March 27
 4331 G. H. Couch. Improvements in roofing tiles and flushing tiles around chimneys and party and parapet walls. March 27
 4332 G. H. Couch. Improvements in ridge, hip and wall tiles. March 27
 4872 D. Cottier, London. Improvements in the production of imitations of stone, marble, terra-cotta, and such like, for the decoration of buildings, statuary, and other surfaces. April 7
 4977 G. Spink, London. Improving the manufacture of bricks by means of a bottom panel, the effect of which is to economise the consumption of raw material, and improve the surface and quality of the brick, and facilitate the drying of the brick. April 9
 5189 W. Benson and L. Gunning, London. Improvements in means for imparting surface designs or patterns to bricks, tiles, and other like articles. April 11
 5321 M. Hussey, London. Improvements in roofing and other tiles. April 16

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

5001 W. R. Lake—Communicated by A. van Berkel. Preservation of wood blocks for paving purposes. March 30
 6025 W. Montgomery. Fire-resisting cement. March 30
 7082 J. F. Ebner. Adhesive anti-dry-rot composition for securing parquet flooring to stone, etc.
 7189 W. Joy. Manufacture of cement, and apparatus therefor. April 2
 7311 G. M. Garrard. Presses for pressing tiles. March 26
 7339 H. R. Snelgrove. Fire-proof ceilings and floors, and blocks or tiles therefor. April 9
 7967 A. H. Stott, J. A. Stott, and A. H. Stott, jun. Fire-proof flooring. April 9

8306 H. R. Vaughan. Mouthpieces and dies for machines, etc., for manufacturing bricks from plastic clay. April 20
 12383 A. C. Ponton. Manufacture of artificial stones and concretes. April 6

1886.

189 L. J. Cadwell. Drying apparatus, chiefly for granular, pulverulent, and similar substances. March 30
 1912 G. Wooliscroft and T. Freeman. Machinery for and method of constructing tiles of an improved construction. April 20
 2659 C. Spaekman. System of drying the prepared mixture of raw materials for the manufacture of Portland cement. March 26

X.—METALLURGY, MINING, ETC.

APPLICATIONS.

4020 G. Chapman, Glasgow. Preparing purple ore or other fine ore of iron for smelting. March 23
 4054 C. L. Hartsfeld, London. Portable blast furnace plant. Complete specification. March 23
 4113 G. Dyson, Leeds. Apparatus for securing the chaplets used in supporting cores for castings. March 21
 1177 J. W. Wailes, Liverpool. Improvements in and in connection with furnaces and regenerators for use in the production of steel. March 25
 4200 A. H. Anderson and J. Noad, London. Improvements in and connected with the extraction of gold and other precious metals from ores and other substances or products containing such metals. March 25
 4340 A. Beaudry and F. H. Cunningham, London. Improvements on power hammers for forging iron and steel. March 27
 4369 T. H. Johns, London. Improvements in process and machinery for cleaning tin andterne plates. March 29
 4379 C. T. Cayley, London. Improvements relating to the hardening or tempering of steel bullets or projectiles and similar articles, and to apparatus therefor. March 29
 4536 W. Penrose and W. Hackney, Swansea. Improvements in the manufacture of open hearth steel. April 1
 4631 D. Williams, Swansea; and E. Jones, Lee. Apparatus for cleaning tin,terne, and metal plates. April 2
 4695 J. Noad, London. Improvements relating to the extraction or separation of gold, silver, and platinum from ores and other substances or products containing such metals. Complete specification. April 3
 4723 F. Fenwick, London. Improvements in the treatment of waste tin cuttings. April 5
 4750 J. W. Hall, London—Communicated by G. T. Lewis, United States. An improved process for treating lead and other ore for obtaining the metal therefrom, and for the manufacture of white pigment. Complete specification. April 5
 4800 R. Applegarth, London. Improvements in the manufacture of cores for use in the casting of metals. April 6
 4830 C. L. J. Beech, London. Improvements in the manufacture of tungsten compounds. April 6
 4955 H. Kesterton, Birmingham. Improvements in the manufacture of metallic alloys. Complete specification. April 9
 5060 C. M. Pielsticker, London. Improvements in machinery for the production of bars and plates of steel (and of other metals) direct from the molten metal. April 12
 5142 H. Hall, London. Improvements in the process and apparatus for coating metal plates and sheets with tin,terne, or other metals. April 13
 5222 J. Heath and W. Frost, London. Improvements in blasting and shot firing in mines and in appliances relating thereto. Complete specification. April 14

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

5262 T. Nordenfelt. Furnaces for burning naphtha or other volatile liquids, and especially applicable for melting metals difficult of fusion. March 26
 6353 H. J. Haddon—Communicated by J. Wezel. Apparatus for coating, roughening, or graining metal plates. March 26
 7115 W. Beatson. Improved method of blasting in mines. April 20
 7179 J. H. Johnson—Communicated by La Société Anonyme Le Ferro Nickel. Manufacture or treatment of iron and steel. March 30
 7802 E. Fletcher. Eliminating impurities from pig-iron during its conversion into malleable iron or steel. April 9
 7880 J. P. Reitz. A new bronze. April 9
 12823 W. C. Stiff and H. B. S. Bennett. Manufacture of tubes and ordnance of steel and iron. April 13
 11276 W. E. Everitt. Casting hollow metallic ingots for the manufacture of tubes, and moulds therefor. April 2

1886.

27 F. A. Herbertz. Cupola smelting furnaces. March 30
 3702 E. B. Parnell. Treating certain auriferous and argentiferous material to facilitate the separation of the metals contained therein. April 16

XL.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

4068 J. Weineck, London. Improvements in the process of preparing stearic acid. March 23

4064 J. L. Wade, Glasgow. An improved lubricating compound. March 29

4025 T. B. Harrison, London. A new or improved wash or compound for treating, washing, or cleansing painted and other articles or substances requiring such treatment. April 2

4091 J. Higson, Manchester. Improvements in the manufacture of soap particularly adapted for the removal of warts. Complete specification. April 10

5020 A. J. Boulton, London—Communicated by J. Monterrubio, Spain. Improvements in the manufacture of soap and in apparatus therefor. April 10

5239 E. Tucker, Bayhead, Stornoway. Improvements in treating fish curers' and kipper offal for the purpose of obtaining oil and manure therefrom, and for obviating the nuisance that usually arises from such operation. April 15

5277 H. Lambert and G. Greenwood, London. An improved arrangement of apparatus for expressing oil from oil-yielding vegetable substances, and converting the residue into oilcake. April 15

5328 H. Hall, London. Improvements in the preparation of oils, greases, and fats for use in the manufacture of tin andterne plates. April 16

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

5383 A. G. Brooks—Communicated by R. Gieberman. Refining or separating glycerine from fats and oils. April 20

7972 O. C. Hagemann. Purification of glycerine. April 13

7973 O. C. Hagemann. Purifying and concentrating glycerine, etc. April 20

8054 O. C. Hagemann. Treating soap-leys to obtain products therefrom. April 20

XII.—PAINTS, VARNISHES, AND RESINS.

APPLICATIONS.

4750 J. W. Hall, London—Communicated by G. T. Lewis, United States. An improved process for treating lead and other ore for obtaining the metal therefrom, and for the manufacture of white pigment. Complete specification. April 5

5270 J. B. Melvin, London. Improvements in the manufacture of resinous compounds. Complete specification. April 15

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

1604 T. J. Pearce and M. W. Beardsley. Rendering substances impermeable to air and liquids, and producing a compound suitable for use as an antifouling paint, and in electrical insulation. April 2

8008 P. C. Bunn. Manufacture of pigments from by-products or waste of lead ores. April 16

XIII.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

4277 T. T. Marshall, Canada. Crimping leather. March 26

5019 H. S. Burrow, Nottingham. Improvements in machines for grounding and softening skins or leathers. Complete specification. April 12

5417 J. Palmer, London. Improvements in the process of unhairing or unwooling hides and skins, and preparing them for tanning. April 19

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

7462 T. Nordenfelt. Manufacture of blood albumen. April 9

7818 A. Johnson. Manufacturing and treating leather. April 2

XIV.—AGRICULTURE, MANURES, ETC.

APPLICATIONS.

1526 H. Stevenson and E. J. Theodora Digby, London. Improved artificial manures. March 31

4797 P. Wilson, Glasgow. Improvements in apparatus for distributing artificial manures or other granulated substances. April 6

XV.—SUGAR, STARCHES, GUMS, ETC.

APPLICATIONS.

1328 S. Banner, Liverpool. Improvements in or relating to the dissolving or combining of indiarubber and other like gums, and to the application of compounds so formed to industrial purposes. March 27

4398 A. Rossi and C. Heilfrisch, London. Improvements in the manufacture of dextrine. March 29

4516 P. Jensen, London—Communicated by M. C. P. Barbe, Holland. Improvements in apparatus for the manufacture of refined sugar. Complete specification. March 31

4679 C. W. N. Wallace and C. J. H. Barry, London. Improvements in the manufacture of caramel. April 3

4891 C. D. Abel, London—Communicated by P. S. Sobue, Germany. Improved process for the desaccharification of molasses and sugar-syrups and the simultaneous production of oxalates from the salts contained therein. April 6

4918 O. Inray, London—Communicated by A. K. Kissel, Germany. Manufacture of an elastic compound in imitation of caoutchouc. April 8

5111 J. D. Scott and A. Scott, Glasgow. Improvements in purifying or refining saccharine liquids or syrups. April 13

5399 J. Swindlehurst, Barrow-in-Furness. The "Swindlehurst" patent impervious elastic composition. April 19

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

8000 A. Seyberlich and Trampedach. Manufacture of crystallised grape sugar. April 16

1886.

3727 H. H. Lake—Communicated by La Société Nouvelle des Raffineries de Sucre de St. Louis. Refining sugar, and apparatus therefor. April 16

XVI.—BREWING, WINES, SPIRITS, ETC.

APPLICATIONS.

4071 F. Faulkner and W. Adlam, London. Improvements in aerating brewers' wort and other liquids, and in machinery or apparatus therefor. March 23

4168 W. Spencer and J. Jones, Liverpool. Improvements in the treatment of brewers' worts. March 25

4191 W. A. How, New Malden. Improvements in apparatus and mode of holding or containing therein bicarbonate of soda for generating carbonic acid gas to be used in aerating draught ale or other beverages. March 25

4311 W. W. Crawford, Glasgow. Improvements in maturing alcoholic liquors. March 27

4529 E. L. Pontifex, London. An improved skimmer or apparatus for removing yeast from wort in a fermenting vessel. March 31

4532 E. Hawker, London. A non-intoxicating drink or beverage. March 31

4868 W. Bradford, London. Improvements in cowl especially applicable for malt or other kilns and brewing and distilling utensils. April 6

4919 G. Epstein, London. Improvements in the treatment of yeast. April 8

5071 W. T. Ramsden, London. Improvements in bottling beer and other fermented drinks. April 12

5152 F. Pigeon and W. L. Flanagan, London. Improvements in the manufacture of ale, beer, and porter. Complete specification

5211 J. Hill, London. An improved hydro-pneumatic apparatus for raising or forcing beer or other liquids, applicable also for motive-power purposes. Complete specification. April 14

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, ETC.

APPLICATIONS.

A.—CHEMISTRY OF FOODS.

4062 J. Y. Johnson, London—Communicated by C. Marchaud, United States. Improvements in and apparatus for the treatment of rancid butter and other materials, for purifying, flavouring and mixing the same or the like. Complete specification. March 23

4114 A. S. Krueger, Lenzie, near Glasgow. A preparation for a new beverage similar to coffee. March 24

4207 L. C. Marshall, Glasgow. Improvements in the preparation of animal substances for use as food. March 25

4320 W. W. Nightingale, London. Improvements in the manufacture of transparent ice. March 27

4578 T. D. Lawson and L. C. Marshall, Glasgow. Improvements in the preparation of animal substances for use as food. April 1

4539 R. Ashton, Heaton Mersey. An improved method of preserving eggs. April 2

4989 F. W. Wendenburg, London. An improved process for manufacturing food for cattle and other animals from woodmeal or powder. Complete specification. April 10

B.—SANITARY CHEMISTRY.

4203 L. G. Ghilain, Liverpool. Improvements in the purification and utilisation of sewage, and apparatus therefor. March 25

4512 F. Petri, London. Improvements in the disinfection of sewage, waste liquors, and the like. March 31

4541 T. Reid, Normanton. Apparatus for and mode of clarifying sewage and filtering large volumes of water. April 1

4609 T. G. Hardie, Burnley. The combustion and destruction of town refuse and other matter, also as a crematory—a special form of furnace. April 1

4623 P. Hickey and J. Radcliffe, Manchester. An improved filter for the purification of water and other liquids. April 2

4667 G. M. Nicolans, London. Apparatus for giving off exhalation from tar. April 3

4878 W. F. B. Massey-Mainwaring, London. Improvements in or connected with filter-presses, and in the drying of sewage sludge and other moist matters. April 7

C.—DISINFECTANTS.

4117 A. L. Dussek, London. Improved means for producing antiseptics and disinfectants. Complete Specification. Mar. 24

4551 H. H. Lake, London—Communicated by F. L. Sarmiento, W. G. Grimm, S. P. Sadler, F. J. Sarmiento, and J. A. Wiedersheim, United States. Improvements in disinfecting compounds. Complete specification. April 13.

COMPLETE SPECIFICATIONS ACCEPTED.

A.—CHEMISTRY OF FOODS.

9216 E. Whillier. Apparatus for preserving articles of food. April 9

B.—SANITARY CHEMISTRY.

1885.

6351 A. Howatson, London. Apparatus for separating solid impurities from water or other liquid. March 26

7416 P. A. Maignen. Water softening processes. March 30

7703 B. D. Heatey. Furnaces for burning towns' refuse, and decomposing the fumes therefrom. April 13

7714 P. Smith. Means and apparatus for separating solids and semi-solids from sewage, etc. March 30

7759 J. M. H. Muir, S. H. Johnson, and C. C. Hutchinson. Treatment of sewage. April 9

8183 J. B. Allott. Apparatus for treating the mud, slop, or sweepings removed from roads, etc. April 20

8912 J. B. Spence. Treatment of sewage at or near the outfall. April 6

1886.

2721 R. de Soldenhoff. Furnaces for the desiccation, etc., of precipitants or solids from sludge, or other putrescible substances. April 16

C.—DISINFECTANTS.

1886.

2780 J. G. Swan and R. M. W. Swan. A sheep-dipping and disinfectant composition. March 26

XVIII.—ELECTRO-CHEMISTRY.

APPLICATIONS.

4057 P. Haddan, London—Communicated by J. Crosse, France. Improvements in voltaic piles and accumulators. March 23

4132 M. Bohdanecky and J. Nesetrl, London. Improvements in dynamo-electrical machines. March 24

4214 C. Wells, London. Improvements in electric baths. March 25

4352 T. J. Jones, London. Improvements in voltaic batteries. March 27

4453 M. Bailey and J. Warner, London. Improvements in electrical cells or batteries. March 30

4522 W. S. Squire, London. A process for utilising the spent liquid from certain voltaic batteries. March 31

4523 H. Müller, London. An improvement in induction apparatus or secondary generators. Complete specification. March 31

4553 W. A. Thoms, London. Improvements in the deposition of platinum by electricity. April 1

4555 A. le Neve Foster and F. V. Anderson, London. Improvements in the distribution of and apparatus for transforming continuous electrical currents. April 1

4575 W. J. S. Barber-Starkey, London. Improvements in secondary batteries. April 1

4680 J. D. F. Andrews, London. Apparatus for altering the potential of electrical currents. April 2

4682 F. King, London. Improvements in the automatic electrical distribution and charge of secondary batteries. April 2

4683 F. F. Stögermayr and V. Glassner, London. Improvements in electric generators. April 2

4751 H. S. Maxim, London. Improvements relating to the application and utilisation of magnetism or electromagnetism for the separation of metals and for other purposes, and to apparatus therefor. April 5

4809 W. P. Thompson, Liverpool—Partly communicated by The Cowles Electric Smelting & Aluminium Co., United States. Improvements in or relating to electric furnaces on the "Cowles" principle, to the manufacture of chemicals by means of such furnaces, and to the utilisation of a substance obtainable thereby. April 6

4884 J. Platt, J. Hopkinson, and E. Hopkinson, London. Improvements in dynamo-electric machines. April 7

4937 W. R. Lake, London—Communicated by W. E. Case, United States. Improvements relating to the conversion of heat energy into electrical energy, and to apparatus therefor. Complete specification. April 8

5090 H. Serrin and F. Fesquet, London. Improvements in apparatus for measuring the consumption of electricity. April 12

5092 A. Rüst, London. Improvements in thermo-electric generators. April 12

5176 C. L. Baker, Manchester. Improvements in dynamo-electric and electro-dynamo machines. April 11

5215 A. Campbell. Improvements in electrical batteries. April 11

5218 B. Pell, London. An electrometer. April 11

5223 P. Ward and Sir S. J. Blanc, London. Improvements in insulating materials for electrical purposes. April 11

5273 H. P. Holt, London. Arrangement for mounting and driving dynamo-electric machines. Complete specification. April 15

5298 C. Moseley, Manchester. Improvements in and relating to secondary voltaic battery. April 16

5338 W. T. Goolden, A. P. Trotter, and H. W. Ravenshaw, London. Improvements in means or apparatus for governing dynamo and other machines. April 16

5409 L. Bollmann, Vienna. Improvements in dynamo machines and electric motors. April 19

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

3941 J. Swinburne, Brockley. Dynamo electric machines. March 26

4671 D. G. Fitz-Gerald. Manufacture of elements for voltaic batteries. April 13

5123 W. H. Allen, R. Wright, and G. Kapp. Exciting the field magnets of series-wound dynamo machines. March 30

5491 C. A. A. Capito and M. P. Hardt. Dynamo machines and electro motors. March 30

6037 M. Immisch. Electro motors and dynamo machines. March 30

6325 T. Parker. Dynamo-electric machines. April 6

6964 G. F. Redfern—Communicated by J. B. Neyraud. Electric batteries. April 20

7114 G. E. Dorman. "Gramme" armatures for electric generators and motors. April 16

7733 H. C. B. Chalders and A. J. Thorman. Electrical batteries. March 30

8228 H. I. Harris. Voltaic batteries. April 20

8416 A. Khotinsky. Constructing electrode frames for secondary voltaic batteries. March 30

9302 A. H. Upward and C. W. Fridham. Galvanic batteries. March 30

11629 B. M. Drake and J. M. Gorham. Instruments for measuring electric currents. April 16

1886.

932 A. Le Neve Foster and F. V. Anderson. Improvements in dynamo-electric machines, and in the transmission of power therefor. March 26

1493 H. J. Allison—Communicated by W. L. Voelker. Dynamo-electric machines and motors. March 26

3726 H. H. Lake—Communicated by J. Serson. Galvanic batteries. April 16

XIX.—PAPER, PASTEBOARD, Etc.

APPLICATIONS.

4050 R. Horrox, Liverpool. Improvements in the manufacture of paper, and in apparatus therefor. March 23

4934 J. B. Seammell, London. Improvements in the manufacture of paper for cigarettes. April 8

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

6840 R. C. Menzies, C. F. Cross, and E. J. Bevan. Treatment of fibrous substances for the manufacture of paper pulp and textile fabrics. March 30

7495 H. J. Haddan—Communicated by C. H. Voigt. Preparing fodder from certain waste products obtained in the manufacture of cellulose or paper pulp. April 13

8073 C. C. Springer. Construction of boilers for treating wood and other fibre in the manufacture of paper and other pulp. April 20

10543 C. J. Richardson. Apparatus for the manufacture of paper. March 30

XX.—FINE CHEMICALS, ALKALOIDS,
ESSENCES, AND EXTRACTS.

APPLICATION.

4392 A. Morand, London. Improvements in the manufacture of tannin extract and similar vegetable extracts, and in apparatus employed therein. March 29

COMPLETE SPECIFICATIONS ACCEPTED.

7527 H. N. Draper, Rathmines. Preparation of a colourless or decolourised solution of iodine. Date ?

7113 D. B. Dott. The artificial production of codeia. April 2

XXI.—EXPLOSIVES, MATCHES, Etc.

APPLICATIONS.

1116 J. Farnsworth, Manchester. Manufacturing a friction signal and destructive bomb, called "The friction bomb." March 21

4265 H. C. Seddon, London. Improvements in percussion fuses for projectiles. March 26

4525 G. A. Sweetser, London. Improvements in the manufacture of cigar lights, fuses, or vesuvians, and apparatus therefor. March 31

4791 H. Schwoneweg, London. Improvements in explosives. April 6

5330 H. E. Newton—Communicated by A. Nobel. Improvements in the manufacture of explosive compounds. April 16

5331 H. E. Newton—Communicated by A. Nobel. Improvements in the manufacture of explosive substances. April 16

5385 R. Cole Gardner, London—Communicated by T. Gibson, France. Improved compounds or ingredients for producing explosions or expansive action in engines for motive-power purposes, and in parts of engines therefor. April 17

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

6591 H. S. Maxim. Improvements in guns and explosive projectiles therefor. April 6

8137 O. Jones. Percussion fuses. April 16

THE JOURNAL OF THE Society of Chemical Industry:

A MONTHLY RECORD

FOR ALL INTERESTED IN CHEMICAL MANUFACTURES.

No. 5.—VOL. V.

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NOTICES.

ANNUAL GENERAL MEETING.

The next Annual General Meeting of the Members of the Society of Chemical Industry will be held in Liverpool on Wednesday, Thursday, and Friday, July 14, 15, and 16 next.

PROGRAMME OF PROCEEDINGS.

At 11 a.m. on the morning of Wednesday, July 14, the Members will meet in the new Chemical Theatre of the University College, Brownlow Street, to transact the ordinary business of the Society, to elect Office-bearers, and to hear an address by the President. By permission of the College Authorities, Members will have an opportunity of inspecting the new laboratories, both before and after the meeting. In the afternoon alternative excursions have been arranged to the following places of interest:—(a) The International Exhibition; (b) The Liverpool Gasworks; and (c) other works in the city, particulars concerning which will be duly announced on the time-card inserted in the June issue of the Journal. In the evening, at 7 p.m., the Annual Dinner will take place at the Adelphi Hotel. Dinner tickets, 10s. 6d. each (exclusive of wine), may be obtained on application, accompanied by remittance, to the Honorary Secretary of the Liverpool Section, Mr. W. P. Thompson, 6, Lord Street, Liverpool. Application before July 2 is requested.

Thursday, July 15.—At 10.30 a.m. Members will proceed to inspect the Albert Dock warehouses. At 12.30 they will embark on a special steamer for a sail up the Mersey; lunch will be provided on board. On returning, Members will disembark at the new North Dock to inspect—(a) the Graving Docks, with their hydraulic machinery; (b) the new grain silo warehouses and elevator; and (c) a transatlantic steamer. At 3.30 p.m. Members will re-embark to pay a visit to one of the following:—(a) The Great Float, Birkenhead; (b) Messrs. Laird's Shipbuilding Works; returning home by the Mersey Tunnel or by ferry as preferred. In the evening, at 8 p.m., there will be a *Conversazione and Reception* by the President at the Walker Art Gallery and Picton Reading Room.

Friday, July 16.—In the morning excursions will be made to Widnes and St. Helens; and in the afternoon to Crewe Railway and Steel Works.

Members are specially requested to note that the date of the Meeting has been changed from July 7, 8, and 9 to Wednesday, Thursday, and Friday, July 14, 15, and 16.

In accordance with the provisions of Rule 18 of the Bye-laws, notice is hereby given that those Members of

Council whose names are placed in italics in the annexed list, will retire from their respective offices at the forthcoming Annual General Meeting.

Mr. David Howard has been nominated to the office of President, and Mr. E. K. Muspratt has been nominated Vice-president under Rule 11.

Sir H. E. Roscoe, M.P., has been nominated Vice-president under Rule 24; Dr. Ferdinand Hurter, Mr. John Williams, and Mr. Philip Worsley have been nominated Vice-presidents under Rule 8; and Mr. Eustace Carey has been nominated Ordinary Member of Council under Rule 17, in the place of Mr. John Williams, nominated Vice-president.

The Treasurer and Foreign Secretary have been nominated for re-election.

Members are hereby invited to nominate fit and proper persons to fill four vacancies among the Ordinary Members of Council under Rule 18. Special nomination forms for this purpose can be obtained from the General Secretary upon application.

Extract from Rule 18.—"No such nomination shall be valid unless it be signed by at least ten members of the Society, who are not in arrear with their subscriptions, nor unless it be received by the General Secretary, at the Society's Office, at least one month before the date of the commencement of the Annual General Meeting, to the election to take place at which it refers. Nor shall any such nomination be valid if the person nominated be ineligible for election under Rules 12 or 15. No member shall sign more than one nomination form."

PROPOSED AMENDMENT OF BYE-LAWS.

Notice is hereby given, in accordance with Rule 54, that it will be proposed to the forthcoming Annual General Meeting to further amend the Society's Bye-laws as follows:—

Bye-law 1.—That the words "and is established in accordance with the provisions of the Literary and Scientific Institutions Act, 1854," be added after the word "Industry."

Bye-law 5.—That the word "or" be inserted in the third line thereof between the words "Council" and "a professional."

Bye-law 27.—That the words "One Guinea" in the first line thereof, be replaced by the words "Twenty-five Shillings."

Bye-law 29.—That the words "is more than four months in arrear," in the second line thereof, be replaced by the words "has not been paid."

Bye-law 37.—That the word "President" in the second line thereof, be replaced by the word "Chairman."

Bye-law 42.—That the words "is in arrear with" be replaced by the words "has not paid."

Bye-law 49.—That the date "31st of December" be replaced by the date "15th of June."

Bye-law 54.—That the word "given" in the last line but one thereof, be replaced by the word "posted."

The supply of copies of the Journal for January, 1882, being now exhausted, the Secretary would be glad to receive communications from members possessing extra copies of that number, in good condition, with a view to purchase.

Should sufficient applications for complete sets be received, the number will be reprinted.

In reply to numerous inquiries, members are hereby informed that no tickets for the Colonial Exhibition have been supplied to the Secretary.

CHANGES OF ADDRESS.

C. M. Aikman, 1/o Partick Hill; 183, St. Vincent Street, Glasgow.

Thos. Akitt, 1/o Lenzie; c/o The Indigo Co., Limited, Behar, Bengal, India.

A. H. Allen, 1/o Ash Mount; Sydenham Cottage, Park Lane, Sheffield.

J. H. Beckett, 1/o Miles Platting; Wilmslow Park, Cheshire.

J. Beveridge, 1/o Cardiff; Erishkoff's Works, Elabrya, Govt. Viatka, via Moscow, Russia.

L. Briant, 1/o Graecchurch Street; 24, Holborn Viaduct, London, E.C.

H. J. Chaney, 1/o Sheffield; North Mexican Silver Mining Co., Cusuhuiriac, Chihuahua, Mexico (via New York and El Paso).

T. J. Flynn, 1/o Guide Bridge; c/o D. Haywood & Sons, Mitcham, Surrey.

S. A. Goldschmidt, 1/o Water Street; Columbia Chemical Works, 29–30, Jay Street, Brooklyn, U.S.A.

G. J. Hamden, 1/o Midcalder; 33, Vane Street, Spring Bank, Hull.

P. Hart, 1/o Ardwick; c/o Tennants & Co., Mill Street, Clayton, Manchester.

W. E. Heys, 1/o Chorlton; 70, Market Street, Manchester.

J. T. Irwin, 1/o Cheetam; The Grange, Polygon Road, Higher Crumpsall, Manchester.

Wilf. Irwin, 1/o Cheetam; The Grange, Polygon Road, Higher Crumpsall, Manchester.

W. J. Johnston, 1/o Thynne Street; 37, Bewsey Street, Warrington.

Wm. Jones, 47, New Broad Street—Journals to c/o Herb. Jones, 6, Lord Street, Liverpool.

W. H. Lake, 1/o Knight's Hill; 11, St. Julian's Farm Road, West Norwood, S.E.

S. D. Leah, 1/o Nottingham; 18, Applegarth Road, Brook Green, Hammersmith, W.

T. Macfarlane, 1/o Montreal; Inland Revenue Dept., Ottawa, Canada.

G. D. Mease, 1/o Tulse Hill; 2, Montrell Road, Streatham Place, London, S.W.

D. Melville, 1/o Kilby Street; 13, Pearl Street, Boston, Mass., U.S.A.

J. M. Milne, 1/o West Regent Street; Royal Infirmary Medical School, 87, Castle Street, Glasgow.

J. J. Morgan, 1/o Rhymney; c/o Jno. Parry, Highfield House, Ebbw Vale, Monmouth.

W. Johnston Saint, 1/o Hess Strasse; Hermann Strasse 5, Schwabing, Munchen, Bavaria.

W. J. Taylor, 1/o Graecchurch Street; c/o L. Briant, 24, Holborn Viaduct, London, E.C.

E. F. Trachsel, 1/o Meath; 14, Walter's Terrace, Swansea.

C. T. Wilson—Journals and communications to 16, Gordon Square, London, W.C.

MEMBER RESTORED ON PAYMENT OF ARREARS.

C. A. Serré, 55, Fulton Street, New York, U.S.A.

CHANGES OF ADDRESS REQUIRED.

W. B. Albright, 1/o Dorchester, Mass., U.S.A.

J. Clark, 1/o 35, Mariners' Cottages, South Shields.

H. W. Fenner, 1/o 7, Vanbrugh Park Road, Blackheath, S.E.

Thos. Leech, 1/o 5, Rumford Place, Liverpool.

LIST OF MEMBERS ELECTED, 24th MAY, 1886.

J. Williams Bevan, Southview House, Shirehampton, near Bristol, lead smelter.

W. W. Butler, Crown Brewery, Broad Street, Birmingham, brewers' analyst.

Aug. H. Gill, Mass. Inst. of Technology, Boston, Mass., U.S.A., assistant in sanitary chemistry.

Martin L. Griffin, Holyoke, Mass., U.S.A., practical chemist.

W. Hogben, Redbraes, Broughton Road, Edinburgh, analyst.

H. G. Holdsworth, West Ham Abbey, London, E., candle maker and wax refiner.

Walter Jackson, 24 Sydenham Avenue, Sefton Park, Liverpool, metallurgical chemist.

G. Jacques, High Street, Uttoxeter, North Staffordshire, pharmacist.

H. L. Lilley, Albert Works, Queen's Road, Manchester, starch and gum manufacturer.

J. A. Meynier, 8, Rue Parc Royal, Paris, chemical merchant.

O. V. Morgan, M.P., 13, The Boltons, South Kensington, S.W., crucible manufacturer.

A. G. Phillips, 20, Canning Street, Liverpool, manager, Widnes Metal Co.

A. Twikey, 392, Coventry Road, Birmingham, pharmacist.

C. N. Waite, Medford, Mass., U.S.A., analytical chemist.

F. T. Walsh, Hamilton Printworks, Lowell, Mass., U.S.A., colourist.

E. H. Winstone, 24, Belgrave Road, London, S.W., colour, ink, and paint manufacturer.

Jas. Wood, Foxhill Bank Printworks, Church, near Accrington, manager.

Wm. Wood, Antwerp, Belgium, bleacher and dyer.

Wm. H. Woodcock, 13, University Place, New York, U.S.A., manufacturing chemist.

Hikokuro Yoshida, Imperial University, Hongo, Tokyo, Japan, assistant professor of chemistry.

London Section.

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C. Graham.	John Spiller.
S. Hall.	G. C. Trewby.
A. K. Huntington.	J. Williams.

Local Sec. and Treasurer: Thos. Tyrer,
Garden Wharf, Church Road, Battersea, S.W.

MEETINGS, SESSION 1885-86.

ORDINARY MEETING POSTPONED TILL TUESDAY,
JUNE 8.

June 8.—Dr. Meymott Tidy — "Chemical Treatment of Sewage."

July 7, 8 and 9.—Annual Meeting at Liverpool.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held Monday, May 3, 1886.

DAVID HOWARD, ESQ., IN THE CHAIR.

THE PURIFICATION OF WATER.

BY A. GORDON SALAMON, A.R.S.M., F.C.S.; AND W. DE
VERE MATHEW, F.I.C.

THE many discoveries recorded in the comparatively modern science of bacteriology, have already provided chemists with the nucleus of an accurate method for estimating the number of organisms in water. The conception of such a process must probably be credited to Angus Smith; but its development and extended introduction is without doubt the result of the researches of Koch, and of the painstaking and laborious work of Percy Frankland. We say that as yet we have only been provided with the nucleus of a method; because, within very restricted limits, it is almost impossible to deduce any really reliable inferences from the experiments, which reveal—doubtless with sufficient accuracy—the presence of the organisms in water. We know that many kinds of organisms may be conveyed into the system in vast quantities, without producing any harmful effect whatever; and we also know that others, if so introduced, will be responsible for the propagation of most serious illnesses. Thus, it is conceivable that a water may contain thousands of harmless germs, and a very minute proportion of disease ensues; and that the few among the thousands may be responsible for injurious effects produced by drinking the water in question. Hence, in the absence of other data, it would seem somewhat premature to condemn a sample of water because it is proved to contain an abnormally large number of organisms. The experiments which prove this require supplementing by others, which will allow of the differentiation of germs which are harmless from those which are injurious; and chemists are, unfortunately, yet without the means of effecting this desirable separation. But there are many facts which would seem to indicate that such a method will eventually be found; and already observations have been accumulated, the accurate interpretation of which may subsequently serve to throw much light upon this branch of the subject. For instance, it has been proved that some organisms, when properly submitted to the process of plate cultivation, will develop colonies which tend to liquefy the medium in which they thrive, whereas others exhibit no especial ten-

dency in this direction. It would seem that colonies which manifest this particular tendency, must have different modes of life, and must excrete different products, from those which do not liquefy; and it would be interesting to know whether those colonies which liquefy are more associated with disease germs than are those which keep the gelatine solid at the temperature of incubation. Such information might probably be gained by inoculating sterilised water with definite disease cultures, and noting the characteristics of the colonies so produced. In any case, we think that chemists and medical men will hesitate to condemn a water as unfit for use because of the large number of colonies which may be developed from it, until such time as they can obtain some reliable information as to the nature and potential influences of the germs which constitute the colonies in question. We are disposed, then, for these and other reasons, upon which we refrain from enlarging, to regard what we may term the bacteriology of water as being still in its infancy; but we do not for one moment deny that it has already been made to yield results which are of the greatest possible practical value. It has, undoubtedly, been made to constitute a fairly accurate test of the amount of filtration to which waters supplied by the London companies have been subjected from month to month; but above all it has been made a means of affording remarkable evidence as to the comparative efficiency of various filtering materials. It is to this latter branch of the subject that we are desirous of directing attention, not so much with a view of emphasising any particular work which we ourselves may have done in connection with the subject, as to attempt to correlate the question of the chemical purification of water with that of the removal from it of its contained micro-organisms.

Dr. Percy Frankland has proved that certain filtering materials possess a remarkable power of removing organisms from water, and we have reason to believe that in many cases he regards the action of these filtering materials as being germicidal in nature; whereas, he looks upon others as being merely mechanical in their action. For instance, the Pasteur-Chamberland filter removes the germs from water, and practically sterilises it; but Dr. Frankland has stated that there is no real difference in the chemical composition of the water before and after filtration through the material of which this filter is composed. We take it, then, that such a filter would act mechanically, whereas spongy iron, which exerts a powerful chemical action upon the water, and at the same time very effectually removes the contained organisms, is germicidal in its tendency. Now, Dr. Frankland has—we had almost said carefully—distinguished between the chemical efficiency of a filtering material, and its capacity for removing organisms. In saying this, we mean that he has treated the two questions as being distinct, inasmuch as he has made no serious attempt to correlate them. We shall hope to prove that there is a very close connection between the power of a material for effecting chemical purification of water, and the removal of organisms; and in so doing we are not without hope that we may in some small way contribute towards the establishment of a fundamental theory, which shall explain the true principles embodied in the purification of water, and which may serve as a guide to those who occupy themselves with this, one of the greatest and most important of modern problems.

We can conceive the possibility of germs being mechanically intercepted during the passage of water through a filtering material; and we can further conceive the possibility of their becoming embodied in a precipitate, which is brought into contact with a water, and is subsequently removed from it. Dr. Frankland

has in several cases indicated that this tendency actually exists; but we cannot regard such a purification as satisfactory, because it does not remove the nutritive materials which are essential to the development of the organisms; and, further, because it may permit of the passage of the more minute spores, which would perhaps escape recognition owing to their not making their appearance upon the gelatine plate within the limits of time permitted to the more fully developed organisms. If sterilisation be effected in this manner, it can at best be regarded as a makeshift purification. It will be admitted that organisms will not multiply without the presence of organic material, which can be broken down for food; and unless this material is removed or rendered incapable of assimilation, we cannot regard the water as being satisfactorily purged of its impurities. On the other hand, if chemical purification be effected, without accompanying germ removal, then we freely admit that it would be far worse than germ removal without chemical purification; and it therefore becomes necessary, in order to obtain the requisites of a theoretically perfect filter, to ascertain the conditions which will permit of both.

It will be advisable, before proceeding further, to attempt to formulate the conditions which permit of chemical purification, and to inquire how these conditions are reconcilable with the experiments and results which we have obtained in the laboratory. It would appear to us that there are but two conceivable actions upon which chemical purification can depend:—

1. It may be the result of a contact action, in which the filter constitutes the catalytic agent. In such a case the filter itself would not undergo change, although it would, by its presence, induce a change in the composition of the organic constituents of the water. Such an action would be analogous in every respect to others which have been recorded in connection with chemical change. Thus, if carbonic anhydride be passed through a hot solution of benzene, containing a trace of aluminic chloride, benzoic acid is formed, whereas no such formation takes place if the aluminic chloride be omitted, although the latter itself undergoes no change whatever. Calcic hypochlorite is decomposed, and oxygen liberated, in presence of cobaltic hydrate, which remains unchanged, whereas no oxygen is evolved with the hypochlorite alone. Then there is the well-known action of manganic dioxide in facilitating the decomposition of potassic chlorate; and, lastly, may be mentioned the union of oxygen and sulphurous acid, or of hydrogen and oxygen in the presence of platinum. We have not yet been able to satisfy ourselves as to whether contact action does or does not play any part in the chemical purification of water. We may possibly be in a position to give some further information upon this point at some future date; and more especially do we hope to be able to do this in connection with the influence of platinised asbestos as the catalytic agent.

2. The filter must itself be capable of undergoing chemical change when in contact with water.

The nature of this change may obviously vary within very wide limits; but, as the result of many experiments, we are inclined to think that liability of filtering material, or, at least, of one of its constituents, to undergo oxidation, is one of the most important essentials to chemical purification. We are further of opinion that the most efficient filtering material will be that which is capable of undergoing the greatest amount of oxidation in the least amount of time. We believe that it is the dissolved gases in the water which act upon the filtering material and thereby induce the chemical changes in the organic

matter of the water. The tendency of this action would seem to be to convert the carbon of the impurity into carbonic acid, and the nitrogen into ammonia. We have, moreover, reason to believe that if water be completely deprived of its contained gases prior to filtration, no satisfactory purification could be effected. The oxidation, or change, may be obtained by the use of a simple filtering material; or it may preferably be effected by the union of two dissimilar elements, or compounds, one of which is liable to change. The latter class of filtering materials have, in our hands, given decidedly the best results, if we consider them with reference to the combination of sterilisation with purification. It will be apparent that the intimate union of dissimilar elements, or bodies, in presence of a water containing carbonic acid, constitutes the conditions favourable to electrical action; and we have found that where such action existed the tendency of the filter was to exert a maximum purifying effect. Moreover, the experiments of Schönbein and Boillot, of Kingzett, and of Paul Bert, support our view, inasmuch as these show that sterilisation is very satisfactorily produced by the action of an electric current. Now, with a few exceptions, we have found that these simple bodies which are susceptible of ready oxidation, or change, diminish in their purifying capacity with the lapse of time. In other words, they become coated with a layer of oxide or carbonate, which is formed in the act of purification, and, as a rule, the oxide or carbonate so formed is inert as a purifying filter. This difficulty, it would appear, may be surmounted in several ways. There may be such a combination of materials, that whereas one tends to oxidise, the other tends to reduce the product of oxidation as it is formed; or the removal of the oxidised body may be brought about by the agency of an electric current, preferably produced by the action of two dissimilar bodies in close contact. In such a case the constancy of the filter would be maintained by a process of depolarisation. We have also found that an electric current from a battery, in addition to that obtained by the contact of two dissimilar bodies, is of immense service in maintaining the constancy of filtering materials. We confess that our ideas in connection with this theory were very much shaken by some observations which Dr. Percy Frankland has made before this and other Societies respecting the influence of coke in promoting sterilisation. He has shown that it exerts a very powerful effect in this direction, and his observations are amply confirmed by our own experiments. But he has also stated, in effect, that the passage of water through coke exerts no chemical purification whatever.

Now, when we consider the porous nature of coke, and grant that the passage of water through it causes the removal of the germs, and that such removal is not due to any primary absorption, but is continued for months after the coke has been in use, and when we have further to conceive that the organisms can be destroyed, with such certainty, without any accompanying chemical change taking place in the water, we are forced into a position which we find ourselves unable to accept. It would be just as reasonable to conclude that an animal could partake of a food which would cause its death, or could be introduced into a fatally poisonous atmosphere, without any chemical change being induced in its system. It might possibly be that the coke acted as a contact agent, and in so doing induced a chemical change in the composition of the water, which change caused the death of the organisms; but that their mere passage through a porous material, in itself absolutely inert, could induce sterilisation, was to us unintelligible. Hence we felt it necessary at once

to challenge Dr. Percy Frankland's assumptions respecting the absence of chemical change; and we deem it necessary to dwell upon the matter now, because the whole value of our results will hinge upon the question as to which of us be correct upon this particular point. We succeeded in obtaining from Dr. Percy Frankland the statement that his two filtrations, the only ones of which chemical analyses are recorded, were made by passing the water through the filtering material contained in about six inches of ordinary combustion tubing. Now, when we consider that the contents of at least a Winchester quart must have been passed through in order to make the necessary estimations, it will be at once apparent that the

for analysis twice through the coke in about 18 hours. In the majority of our recorded experiments, we had, therefore, a filtering depth of about 58 inches. The coke was thoroughly washed, and many litres of water were passed through before a sample was collected for examination. We found that, within limits, no material alteration was effected by varying the rate of filtration. After the filter was once started, the surface of the coke was never allowed to become exposed to the air. Table A below gives some of the results we have obtained in this way.

It will at once be seen that these results in no way accord with those obtained by Dr. Percy Frankland upon the miniature scale. On the contrary, they

TABLE A.—COKE FILTRATION. (PARTS PER 100,000.)
(Fe_2O_3 in Coke = 1.22%.)

	Total Solid Residue.	Organic C.	Organic N.	NH_3	N as Nitrates and Nitrites.	Total Hardness.
1st day—						
Before filtration	23.92	.260	.064	.006	.115	20.30
After „	18.08	.082	.013	.010	0	15.14
3rd day—						
Before filtration	21.90	.439	.133	0	.100	10.42
After „	22.70	.127	.037	.015	.071	17.72
5th day—						
Before filtration	21.58	.261	.066	.006	.126	18.28
After „	23.72	.074	.022	.001	.081	18.00
9th day—						
Before filtration	25.12	.277	.046	.004	.107	18.28
After „	24.84	.088	.030	0	.070	18.10
14th day—						
Before filtration	25.60	.385	.083	0	.092	18.00
After „	25.38	.069	.022	.001	.012	18.22
16th day—						
Before filtration	26.40	.187	.061	.001	.135	20.60
After „	26.20	.098	.030	0	0	20.30
24th day—						
Before filtration	58.61	5.278	9.785	.500	0	23.33
After „	47.68	4.212	8.583	1.000	0	19.10
27th day—						
Before filtration	57.62	5.552	9.171	.650	.011	21.80
After „	48.88	4.390	8.541	1.000	0	20.30

* Grossly polluted samples.

amount of surface exposed to such a relatively large bulk of water was far too small to allow of any accurate idea being formed as to whether any chemical purification was to be effected by constituting coke as the filtering medium. Experiments which one of us had made upon the industrial scale had fully convinced us that coke did effect a very marked chemical purification, and we decided, therefore, to submit it to some laboratory test of an accurate character. We took some good samples of ordinary gas-coke, and powdered them up till they were finely divided. The powder was then introduced into a glass tube 2½ inches wide, and of such a length that we were enabled to have a filtering depth of coke of 29 inches. We allowed the water under examination to pass through this at such a rate that we were enabled to filter the Winchester quart required

show that a most marked chemical purification is effected; in some cases, indeed, quite as emphatic as with spongy iron. This being so, we can fully understand why Dr. Percy Frankland should have found that coke is so strongly germicidal; and we venture to think that if he repeat his experiments upon a scale approaching to ours, he will be the first to confirm the figures we have quoted.

We would here remark, that caution is in all cases necessary before deciding as to whether a sterilisation of water is produced by a purely mechanical filtration. In support of our view, we may instance the beautiful sand found in the bed of one of the Scotch lakes. It was supposed to be extremely pure in every respect, but notwithstanding has been found to be a veritable necropolis of diatoms; and we may further quote some experiments of our own, undertaken

during the course of this investigation, in which we sought to make small plates of mica the inert agent upon which to fix a certain purifying material. We submitted the mica to prolonged heat before using it, and found, contrary to our expectations, that the water was much more impure after filtration than before it. On further examination, we proved to demonstration that the organic impurity was derived from the mica, and this notwithstanding that it is supposed to be a pure silicate of magnesium, and that we had taken the precaution to submit it to the action of prolonged heat before using it. Who shall

weathered it is extremely probable that the iron becomes oxidised, more especially upon the exterior; but if it be used when fresh it will contain metallic iron in relatively considerable quantity. This may be proved by the possibility of collecting hydrogen gas when acting upon coke with acids. Hence, if such coke be powdered so that the interior of the lumps can be thoroughly mixed with the rest of the mass, we have the conditions which we have stated to be favourable to chemical purification—viz., two dissimilar bodies in intimate mechanical contact, one of which is easily susceptible of oxidation. We have,

TABLE B.—FERRO-COKE FILTRATION (CONCENTRATED). (PARTS PER 100,000.)
($\text{Fe}_2\text{O}_3 = 1.166\%$)

	Total Solid Residue.	Organic C.	Organic N.	NH_3	N as Nitrates and Nitrites.	Total H.
Before Filtration	28.34	.212	.134	0	.184	21.20
After do.	24.40	.048	.012	.013	.175	18.40
*Before Filtration ..	81.82	20.121	25.769	.500	.053	21.20
After do.	71.08	11.623	23.418	.400	0	18.40

* Grossly polluted.

TABLE C.—FERRO-COKE FILTRATION DILUTE. (PARTS PER 100,000.)
($\text{Fe}_2\text{O}_3 = 1.744\%$)

	Total Solid Residue.	Organic C.	Organic N.	NH_3	N as Nitrates and Nitrites.	Total Hardness.
1st day—						
Before filtration	29.20	.284	.055	0	.185	19.42
After „	27.18	.079	.011	.004	.152	18.00
8th day—						
Before filtration	27.42	.198	.050	.002	.129	18.86
After „	24.12	.083	.011	.011	.108	17.42
16th day—						
Before filtration	26.76	.224	.054	0	.140	18.50
After „	24.90	.113	.015	.008	.115	17.70
17th day—						
Before filtration	30.46	.345	.061	.004	.177	21.50
After „	27.58	.114	.059	.021	.173	19.10
21st day—						
Before filtration	31.38	.295	.048	0	.273	23.00
After „	30.16	.090	.051	.028	.223	23.30
25th day—						
Before filtration	33.50	.211	.045	0	.265	23.90
After „	30.68	.121	.051	.010	.218	23.60

say, then, that there are not some unknown conditions influencing the sterilising properties of all those filtering bodies at present supposed to act mechanically in producing sterilisation?

And now let us inquire why it is that coke produces so emphatic a chemical purification. We have never yet examined a sample of coke which did not contain iron. In furnace coke its proportion would be more pronounced than in the case of gas coke. When the coke is first made, the iron is probably all in the metallic condition, and is, moreover, in a state of fine division, and in intimate mechanical contact with the carbon, which has reduced it. If it be much

also, when such a mixture is introduced into a carbonated water, all the conditions favourable to electrical action. In considering the probable effect of electrical action upon the chemical purification of water, it should not be forgotten that it will decompose many organic bodies which constitute the polluting agents of water. Thus it has been proved by Schlagdenbaufen (*J. Pharm.* [3], xlv. 100) that urea is converted into ammonia and carbonic acid by electrolysis; and it has also been shown by Erlenmeyer (*Zeit. Ch. Pharm.*, 1861, p. 548) that nascent hydrogen appears to convert hippuric acid into glycocine and hydride of benzoyl. If now we

are correct in our view that the chemical purification in coke is produced in the manner above described, then it should be possible to emphasise the purification by introducing a greater quantity of iron into the coke. We put this to the test in the following manner. The coke previously experimented with was treated in a muffle to redness; then cooled, digested for a long time with a concentrated solution of ferric chloride until it was saturated, and dried. It was then introduced into a muffle, and heated to dull redness to reduce the iron. The ferro-coke, as we term it, thus produced, was thoroughly washed, and the filtrations were then made as before. Table B gives the results obtained.

It will be seen that our predictions were fully verified, and that a most marked increase in the purification was accomplished.

water, we digested the coke previously charged with iron with hydrochloric acid, and maintained it at a considerable heat for about 8 hours. This treatment did not remove all the iron, as we subsequently discovered, or we should have treated with nitro-hydrochloric acid and boiled; but it is fairly safe to conclude that all the metallic iron had been extracted, and that the residue was present in the form of pyrites. After digestion, the coke was thoroughly washed, and filtration allowed to proceed as before. Table D gives the results obtained.

It will at once be seen that the chemical activity of the filter has now become almost nil. Hence, seeing that we can increase the amount of purification effected by increasing the ratio of iron to coke, and materially diminish it by decreasing this proportion, we feel that we are justified in concluding that its

TABLE D.—FERRO-COKE DIGESTED WITH HCl DURING 8 HOURS AND WASHED.
(PARTS PER 100,000.)
($\text{Fe}_2\text{O}_3 = 767\%$.)

	Total Solid Residue.	Organic C.	Organic N.	NH_3 .	N as Nitrates and Nitrites.	Total Hardness.
No. 1.—Before filtration	32.84	.226	.053	0	.265	22.1
After „	32.66	.223	.046	.015	.278	22.1
No. 2.—Before „	32.22	.231	.037	0	.266	22.7
After „	32.54	.171	.035	.005	.221	22.1
No. 3.—Before „	32.54	.292	.063	0	.270	23.0
After „	32.11	.181	.012	.003	.236	23.6

TABLE E.—IRON-COKE FILTRATION. (PARTS PER 100,000.)

	Total Solid Residue.	Organic C.	Organic N.	NH_3 .	N as Nitrates and Nitrites.	Total Hardness.
1st day—						
Before filtration	29.91	.213	.076	0	.252	21.20
After „	24.88	.172	.066	.030	.239	15.14
3rd day—						
Before filtration	29.44	.118	.054	0	.282	21.50
After „	26.70	.152	.053	.009	.250	18.80
9th day—						
Before filtration	28.74	.127	.058	0	.231	20.60
After „	25.92	.125	.073	.028	.210	17.10
10th day—						
Before filtration	28.26	.121	.049	0	.230	20.10
After „	24.66	.071	.024	.005	.207	18.50 Battery.
15th day—						
Before filtration	29.64	.155	.039	0	.269	20.60
After „	26.24	.123	.026	.005	.221	17.40 Battery.

We next tried the effect of a dilute solution of ferric chloride upon a new sample of coke, and proceeded exactly as before. Table C gives the results obtained.

The purification, as we had anticipated, was not so great as when the coke was fully charged with iron. It was, nevertheless, very considerable, but exhibited the characteristics common to all filters of this type. The intensity of purifying effect diminished with the deposition of oxide and carbonate.

In order to clinch the question as to whether the iron had anything to do with the purification of the

presence is essential to the purification, and that it is brought about by the contact of the two dissimilar bodies, iron and coke.

Having ascertained this much, we were anxious to see whether we could overcome the obstacles presented to continuous purification by the formation of oxides and carbonates. We reasoned that it would be possible to render the action continuous by introducing our filter of coke and iron into the circuit of an electric current from a Daniell battery. In this way there would be a tendency to depolarisation; but in any case the electric current would be main-

tained, and the oxidation of a greater quantity of iron would be promoted. In order to test this we varied our experiments in the following manner:—

Instead of using a glass tube, we took one of about the same dimensions of wrought-iron. This we filled with powdered coke, taking the usual precautions to prevent any solid matter being introduced mechanically into the filtered water. In the centre of the coke, and firmly embedded in it, we introduced a carbon rod, which we connected by a wire with one pole of a Daniell battery. Around the exterior of the wrought-iron pipe we fastened a wire which was connected with the other pole of the battery. We did not at first make the connection with the battery, but allowed filtration to proceed until the filter had become practically inert. It will be noticed that this occurred in about three days after the commencement of filtration. Of course, during this period the filter was in continuous use night and day. It will be seen that the use of the battery accomplished a remarkable revivification of the filter, as shown in Table E.

From this and other experiments which we have made, we are disposed to regard an electrical battery as a very valuable adjunct to a chemically purifying, as well as to a sterilising filter, and we propose to continue our experiments in this direction.

to the presence of carbonates, which exert a retarding effect in the reduction, and is expedited by the presence of sodic chloride, due no doubt to the fact that the latter body exerts an intensifying effect upon the electrical action of the couple. But whereas he states the couple has "not the least destructive or corrosive action on the organic matter in water" (*ib.* p. 149), we find that it exerts, as we might have expected, a very powerful action upon it when water is filtered through it. Considerable care was exercised in the preparation of our couple, and a large amount of it, about 3 pounds in weight, was introduced into a glass tube about 12 inches long and 2 inches wide. The usual precautions were taken to prevent any solid matter passing into the filtered water, and the rate of filtration was made to correspond with that of the water passing through coke, etc., in the longer tubes. The couple was very energetic, and an abundance of hydrogen was generated in presence of water at a temperature of 19° C. Table F gives the results obtained.

It will be seen that, in the first instance, this couple constitutes a filter of remarkable power; but, in accordance with the observations of Williams with respect to its application to the estimation of nitrates, its intensity diminishes with the gradual accumula-

TABLE F.—ZINC-COPPER COUPLE FILTRATION. (PARTS PER 100,000.)

	Total Solid Residue.	Organic C.	Organic N.	NH ₃ .	N as Nitrates and Nitrites.	Total Hardness.
No. 1.—Before filtration	34.74	.250	.061	.026	.288	22.4
After "	11.94	.033	.025	.130	0	7.5
No. 2.—Before "	32.28	.190	.069	0	.271	22.7
After "	11.96	.113	.105	.100	0	6.5
*No. 3.—Before "	33.16	.188	.043	.002	.292	23.0
After "	12.10	.115	.108	.100	0	7.5
*No. 4.—Before "	24.10	.209	.011	.001	.316	22.7
After "	12.30	.106	.051	.100	0	7.5
†No. 5.—Before "	33.18	.216	.070	.010	.287	22.4
After "	30.60	.138	.050	.100	0	8.1

* Temperature of water maintained at 50° C.

† NaCl added to water.

If, now, we have deduced correct inferences from those experiments to which we have already invited your attention, it should be possible for us to constitute a filter out of the combination of any two dissimilar elements, one of which is subject to oxidation when in contact with water; and the amount of purification should vary directly with the dissimilarity of the bodies constituting the filter. Hence a very powerful purifying agent should be provided in the zinc-copper couple, and we determined, therefore, to experiment with this material. In order to filter water through a considerable thickness of this couple, it was advisable to employ the dry and not the wet couple; and it is well we should say that we have carefully considered the experiments of Williams (*Chem. Soc. Journ.* 1881), and that in most respects our results accord with his. Inasmuch, however, as he has not published complete analyses of the organic constituents of water before and after treatment, it is somewhat difficult to compare our experiments with his; and more especially because he worked with the wet couple, and we have experimented with the dry. In any case, we have found, with him, that the action is completely to convert the nitrogen of the nitrates into ammonia, and that the action is uncertain owing

to the presence of carbonates, which exert a retarding effect in the reduction, and is expedited by the presence of sodic chloride. It is worthy of mention that we could not discover a trace of zinc or copper in solution after the water had been subjected to this method of filtration.

Now, it will be noticed that throughout these experiments the waters, after filtration, have all exhibited a diminution in hardness; and in some cases, more particularly with the zinc-copper couple, the diminution has been very remarkable. It was necessary to ascertain the cause of this, and we proceeded to do so in the following manner:—Distilled water was treated with caustic lime, and, after cooling, carbonic acid was passed into the water to saturation. To a portion of this artificially carbonated water was added pure and freshly precipitated ferric hydrate, and to another portion was added pure zinc hydrate, equally fresh. Both samples were now frequently agitated and strongly aerated. In the first experiments the respective hydrates were allowed to be in contact with the waters for about five minutes; but in the second this was increased to about twelve hours, and in each case there was abundant agitation. The hardness of the carbonated waters was deter-

mined before and after this treatment, with the following results :—

Hardness of artificial water.....	913
" after treatment with ferric hydrate (5 min.)	786
" " " " zincic " (12 hrs.)	886
" " " " ferric " (12 hrs.)	113
" " " " zincic " (12 hrs.)	713

It will thus be seen that ferric and zincic hydrates will decompose the acid carbonate of lime in a manner similar to that effected by Clarke's process ; indeed, the amount of reduction which is effected by ferric hydrate is very great. These experiments satisfactorily explain the reduction in hardness, and show, moreover, why filters of this type (of which so many are in the market) should gradually diminish in purifying intensity with the accumulation of carbonate.

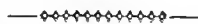
It only remains for us to show that those materials which exert a maximum chemical purifying effect are also the most efficient in producing sterilisation ; and the theory which we advanced at the commencement of this paper will then, we think, be proved.

Samples of water were submitted to plate cultivation, and every precaution was taken to ensure accuracy in accordance with the most recent instructions of Koch, Klein, Bischof and Crookshank, and P. Frankland. We append a table of some of the results obtained by us :—

ORGANISMS IN 1cc. OF WATER (KOCH-FRANKLAND PROCESS).

	A.	B.
Before filtration.....	1930 colonies	162 colonies
Electro current (Sn electrodes).....	1200	22
Coke.....	18	—
Ferro coke.....	0	0
Zinc-copper couple.....	0	0
Iron+coke+battery.....	—	0

We have not thought it necessary to repeat the experiments of Dr. Percy Frankland with respect to the sterilising properties of those bodies, such as spongy iron, animal charcoal, etc., which admittedly influence the chemical composition of the water passing through them, because we are sufficiently convinced of their accuracy. We have as yet confined our attention to what we regard as test cases, and it will, we think, be admitted that we are most fully confirmed in our view that chemical purification of water is accompanied by germ removal. We believe, moreover, that the time is not far distant when the two questions will not be considered except in conjunction with one another. It is our intention to continue our experiments upon this basis, because we are convinced that it is the true one from which to attack the question of filtration. We can but hope that this preliminary statement of some of our results may induce others to take up the work from a similar standpoint ; and in so doing we are convinced that they will materially contribute towards the solution of one of the most pressing and vital of our social problems.



ON RECENT IMPROVEMENTS IN THE TREATMENT OF WATER FOR TECHNICAL PURPOSES.

BY WM. MACNAB AND G. H. BECKETT.

In a great number of cases the water which the manufacturer can command for use in steam boilers and the various processes and operations in his works, is very unsuitable on account of the lime and magnesia salts in solution.

Attention has been frequently drawn to the obvious advantages of softening water before using it in boilers, and for washing purposes ; and, although the chemical treatment to be described has been proposed, we have not found any detailed account of the actual results obtained where the aim has been to remove both the temporary and permanent hardness.

Such a process is now being applied to large quantities of waters from various sources, and the results obtained in practice on the large scale thereby acquire a special interest. This process consists in the use of caustic soda and lime. The use of carbonate and even caustic soda has been practised ; but these reagents had been almost always placed in the boiler itself, in which the precipitation consequently took place. The results we have now to describe have been obtained by treating the water continuously with a mixture of caustic soda and lime water, in such proportions as to reduce the hardness of the water to the lowest attainable point, at the same time avoiding an excess of the reagent.

The treatment is carried on in an apparatus which allows of the separation of the precipitate, and the water which comes away is practically free from lime and other substances which could form a scale in a boiler.

For the sake of convenience we shall first take the consideration of the chemical treatment only, and shall briefly refer to the other methods which have been proposed and tried. The chief of these are :—

(1.) *Carbonate of Soda Method.*—Where this is employed to precipitate lime and magnesia from the water before it is introduced into the boiler, an excess must be used to combine with the free carbonic acid in the water, forming sesquicarbonate, and the treated water then contains excess of alkali, which is objectionable for most purposes, besides which the precipitation is incomplete unless heat be also employed.

(2.) *Lime and Chloride of Barium.*—The chief objection to this method is that the permanent hardness is not removed, the sulphate of lime being simply converted into chloride.

(3.) *Alkaline Oxalates.*—This is expensive, and only lime salts are affected.

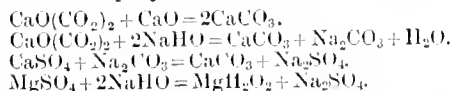
(4.) *Magnesia.*—This requires a temperature of 80° C. to complete the reaction.

(5.) *Hydrochloric Acid.*—This is used to decompose the temporary hardness, forming a soluble chloride, but does not remove anything from the water.

(6.) *Lime.*—This removes only the temporary hardness, and of course is excellent so far as it goes.

The lime and caustic soda method removes practically all the hardness, both temporary and permanent, does its work without the aid of heat, and gives a water containing only soluble soda salts and no excess of alkali.

Now, in order to precipitate salts other than the carbonate, it is necessary to employ carbonate of soda, and this is provided by the caustic soda and by the carbonic acid usually present in the water in the free state ; but only so much caustic soda is used as is requisite to decompose the sulphates, chlorides, etc., and lime water is used to remove the carbonic acid which is not required for the caustic soda. To precipitate magnesium salts, caustic and not carbonate of soda is necessary. The following equations exemplify the reactions :—



Caustic soda is preferable to carbonate for this process, for, although the carbonate is causticised by lime, the reaction is not complete in the cold, and the solution made from the carbonate is not so convenient to use in consequence of this. But where the permanent hardness due to lime salts is excessive, or the quantity of free carbonic acid is too small, it becomes necessary to supplement the caustic soda with carbonate of soda in a quantity sufficient to make up the total quantity of alkaline carbonate required to decompose this hardness. In our experience treatment with lime and caustic soda is the most suitable in the majority of cases.

We shall now describe the application of the method, and for this purpose shall take the case of the water supplied by one of the Metropolitan companies. It has the following analysis:—

Grains per Gallon.		Grains per Gallon.	
CaCO ₃	17.46		
CaSO ₄	2.75		
MgSO ₄	1.72	Free CO ₂	7.23
MgCl ₂ .....	.42	Hardness.....	21.4
NaCl	2.00		
SiO ₂ .....	.56		
Fe ₂ O ₃ , Al ₂ O ₃			
<hr/>			
24.91			

To neutralise all the free carbonic acid in this water 13lb. of lime or 130gals. of clear lime water would be required for 1000gals. of water; but a part of this carbonic acid is used in combination with soda to decompose the sulphate of lime, so that only 11lb. of lime or 110gals. of lime water will be required. Of caustic soda 0.24lb. will be required for the calcium sulphate, and 0.24lb. for the magnesia salts. If, then, 110gals. of lime water, which contain also .48lb. of caustic soda, be added to 1000gals. of water corresponding to the above analysis, a precipitate will be formed, and if this be allowed to settle the supernatant water will contain only about 3° of hardness, and the following is an analysis of such water as obtained on the large scale:—

Grains per Gallon.		Hardness = 2.6°
CaCO ₃	1.26	
MgCO ₃	1.12	
Na ₂ CO ₃	3.85	
Na ₂ SO ₄	4.83	
NaCl	2.45	
SiO ₂ , Fe ₂ O ₃ , Al ₂ O ₃ .....	.56	
	<hr/> 14.07	

A few other analyses illustrating the results obtained on the large scale may be also of interest:—

ORIGINAL WATER.		AFTER SOFTENING.	
Grains per Gallon.		Grains per Gallon.	
CaCO ₃	13.58	CaCO ₃	2.45
CaSO ₄ .....	.90	MgCO ₃ .....	.56
MgSO ₄ .....	.21	Na ₂ CO ₃	1.12
MgCl ₂ .....	.72	Na ₂ SO ₄	1.68
NaCl	2.45	NaCl	4.06
SiO ₂ , Al ₂ O ₃ , Fe ₂ O ₃ .....	.28	SiO ₂ , Fe ₂ O ₃ , Al ₂ O ₃ .....	.21
	18.14		10.08
Hardness	15.°	Hardness	3.°
Free CO ₂	7.85		
—			
CaCO ₃	16.80	CaCO ₃	1.75
CaSO ₄	5.71	CaSO ₄	2.87
Ca(NO ₃) ₂	6.94	MgSO ₄	1.68
Mg(NO ₃) ₂	4.08	Na ₂ SO ₄	1.47
NaNO ₃ .....	.95	NaNO ₃	9.52
NaCl	6.34	NaCl	6.16
SiO ₂ , Fe ₂ O ₃ , Al ₂ O ₃ .....	.28	SiO ₂ , Fe ₂ O ₃ , Al ₂ O ₃ .....	.21
	41.10		23.66
Hardness	28.°	Hardness	5.°
Free CO ₂	8.93		

In this water the reduction was intentionally stopped short of the limit, by using an insufficiency of caustic soda, to avoid the presence of any carbonate of soda; but this latter has not been found to be objectionable in such small quantities as in the first two instances cited above.

Many users of water for boilers have expressed an objection to using caustic soda for softening the water, as they imagined that the water so treated would

enter their boiler charged with caustic soda. It is hardly necessary to state here that the caustic soda, added to the water in regulated quantities, is practically all transformed into the sulphate or chloride, salts which are perfectly harmless for nearly all the technical purposes to which water is applied. An inspection of the foregoing analytical figures will show the ultimate destination of the caustic soda.

It will thus be seen that this process admits of practically all the lime and magnesia, however combined, being removed from such natural hard waters, equivalent quantities of sodium sulphate or chloride being substituted for the corresponding lime and magnesia salts.

It is impossible to entirely remove the lime and magnesia from water by this process, owing to the slight solubility of carbonate of lime and hydrate of magnesia, and in fact the amount of this residual hardness is subject to some variation according to the impurities present, and the time given for the reaction. As far as carbonate of lime is concerned, its solubility seems to be fairly constant, and amounts to about two grains per gallon or one part in 35,000, but the solubility of the magnesia precipitate is liable to variations, which we have endeavoured to investigate.

In this process the magnesia will be precipitated as hydrate or carbonate, according as hydrate or carbonate of soda is used as the precipitant, and of these two magnesia hydrate is the most insoluble. If a solution of a magnesia salt be precipitated with excess of lime water or hydrate of soda, the resulting solution will contain only about one part of magnesia in 50,000 parts of water. But if the caustic soda contained carbonate so as to cause the magnesia hydrate to be mixed with carbonate, a larger quantity of magnesia will remain in solution; and our experiments tend to show that when an excess of caustic soda is used with the view of depriving the precipitate of carbonic acid, the object is only partially attained, and it seems that carbonic acid in solution, even in presence of an excess of caustic soda, will operate by causing more of the magnesia to remain in solution.

Of course these considerations are only of importance when dealing with very dilute solutions of magnesia, as in natural waters.

By the use of lime water the carbonic acid may be removed from the solution, and its solvent effect thereby destroyed; but it is in the difficulty of adjusting the proportion of lime water, so as to avoid an excess over a sufficiency, that the trouble of treating magnesian waters arises, and where a large quantity of magnesium salts is present, it is always difficult to reduce the residual hardness to a minimum.

The difficulty of adjusting the lime and caustic soda so as to obtain the lowest practical result, is illustrated by the following experiment, where the reagents were added in quantities calculated to precipitate all the lime as carbonate, and the magnesia as hydrate. 1gram. MgO and 14gram. CaO per litre in solution as sulphates treated with 265gram. Na₂CO₃, and 200gram. NaHO—that is, equivalent quantities—for 2½ hours in the cold, gave—

CaO unprecipitated	.037gram. per litre = 4.6° hardness
MgO	.054 " " = 9.4 " "
Total	14.0

showing that part of the CO₂ went to the magnesia, with the effect of preventing full precipitation both of the lime and magnesia.

But the use of such treated water will not necessarily give rise to the formation of scale, because a

temperature of from 60—70° C. is sufficient to complete the reaction, giving a full and immediate precipitation of the lime as carbonate, and the magnesia as hydrate, which are then present in the boiler in a state of suspension only, and do not incrust.

The use of water-fully treated with lime and soda has established the fact that practically no incrustation is formed in the boiler, the lime and magnesia which remain in the water to the extent of from two to four degrees of hardness being in a state from which a boiling temperature causes them to be precipitated, so that all that is found in a boiler after say three or six months' work is a small quantity of powder. It seems scarcely necessary to point out that this result is only seen when the experiment is commenced with a really clean boiler. In general it is found that boilers after becoming incrustated with scale during work with ordinary waters are well cleaned only on the upper plates of the centre flues, whilst the underside of the flues and the bottom of the boiler are more or less imperfectly cleaned, and the portions in the narrow spaces between the flues and the shell of the boiler are very seldom cleaned, owing to the great difficulty of reaching these parts with chipping tools. In general, therefore, the treated water has to be used in such a partially cleaned boiler, and in course of time such old deposits of scale become loosened, so that a slight force only is required to detach them, and finally the boiler becomes and remains practically clean. It is worthy of remark that when portions of a boiler contain old scale, the use of softened water will actually show a thin scale on the top of the flue, which is the part generally selected for trying the effect of the method in trials of processes for preventing incrustation. Now this thin scale has its origin in the old scale on other parts of the boiler, which dissolves partially in the boiling soft water, and this on evaporation leaves the dissolved scale again on the top of the flue as new scale. This is particularly the case with calcium sulphate, which predominates in scale formed in this way. It may be noticed here that such scale is very adherent to the iron as long as it is thin, but as soon as the thickness has reached about a sixteenth of an inch it peels away readily, the reason apparently being that its mass gives the stability sufficient to prevent it following the small movements of contraction and expansion of the iron.

That there must be a considerable saving of fuel where the boiler is kept free from incrustation, there is of course a universal agreement, but a reference to figures given by various writers seems to show that the results are obtained more by calculation from small experiments than by actual trials with boilers, and in truth it is very difficult to determine the influence of scale in the work done by a boiler, because of the many attendant sources of error. It might be thought that the temperature of the gases after leaving the boiler would give the necessary data, but this is again modified by the proportion of air admitted through the firebox, and also by the leakage of air into the flues through the brickwork. Perhaps a fair idea might be arrived at by analyses of the issuing gases taken at the same time with the temperature, but this we have not had the opportunity of investigating. It seems to us that evaporation results would not sufficiently exclude the errors introduced in the stoking.

When a water which is to be softened contains organic matter in such quantity and kind as to impart a colour to the water, or at least to impair its brightness, the employment of a soluble salt of alumina (or ferric oxide) is resorted to, and the quantities of lime and soda are so adjusted as to pre-

cipitate the alumina as hydrate as well as to remove the hardness of the water. The use of precipitated alumina has the further result of causing the lime and magnesia precipitate to settle rapidly, which would not always be the case in the absence of the alumina hydrate, for such impure waters have a tendency to remain turbid for a long time after addition of lime or lime and soda; the bulk of the precipitate will settle, but a part remains in suspension. Also if the amount of original hardness in the water is small, the whole precipitate may be so finely divided that it takes a longer time than usual to settle, and in this case, too, the addition of a small quantity of alumina salt will bring about the desired result. The alumina hydrate envelops the finer as well as the larger particles of precipitate and carries the whole down, and where organic matter is present it unites with the alumina to form a lake, and is so removed, as is already sufficiently well known. The quantity of sulphate of alumina required varies from one to seven-tenths of a pound per 1000 gallons, according to the quantity of organic matter present. Where sulphate of alumina is employed, and if the water is to be softened, provision must be made for the saturation of the sulphuric acid by caustic soda, lime being used for this purpose only where a sewage or waste water is to be defecated, and sometimes it is advantageous to employ aluminate of soda. For wool-washing it is, of course, of the utmost importance to have soft water, and in some cases, where the available water contained only from four to five degrees of hardness, and was tinged slightly brown from peaty matter, treatment with a small quantity of sulphate of alumina and caustic or carbonate of soda has effected a very satisfactory improvement, the treated water being clear and colourless, with a hardness of two degrees. The sludge from such a treatment was brown coloured, and had the following composition after having been dried at 135° C. :—

Matter driven off at red heat	45.0%
SiO ₂	11.0
Al ₂ O ₃	16.7
Fe ₂ O ₃	10.3
CaO	8.6
MgO	7.0
CO ₂ , other acids, etc.	1.4
	<hr/> 100.0

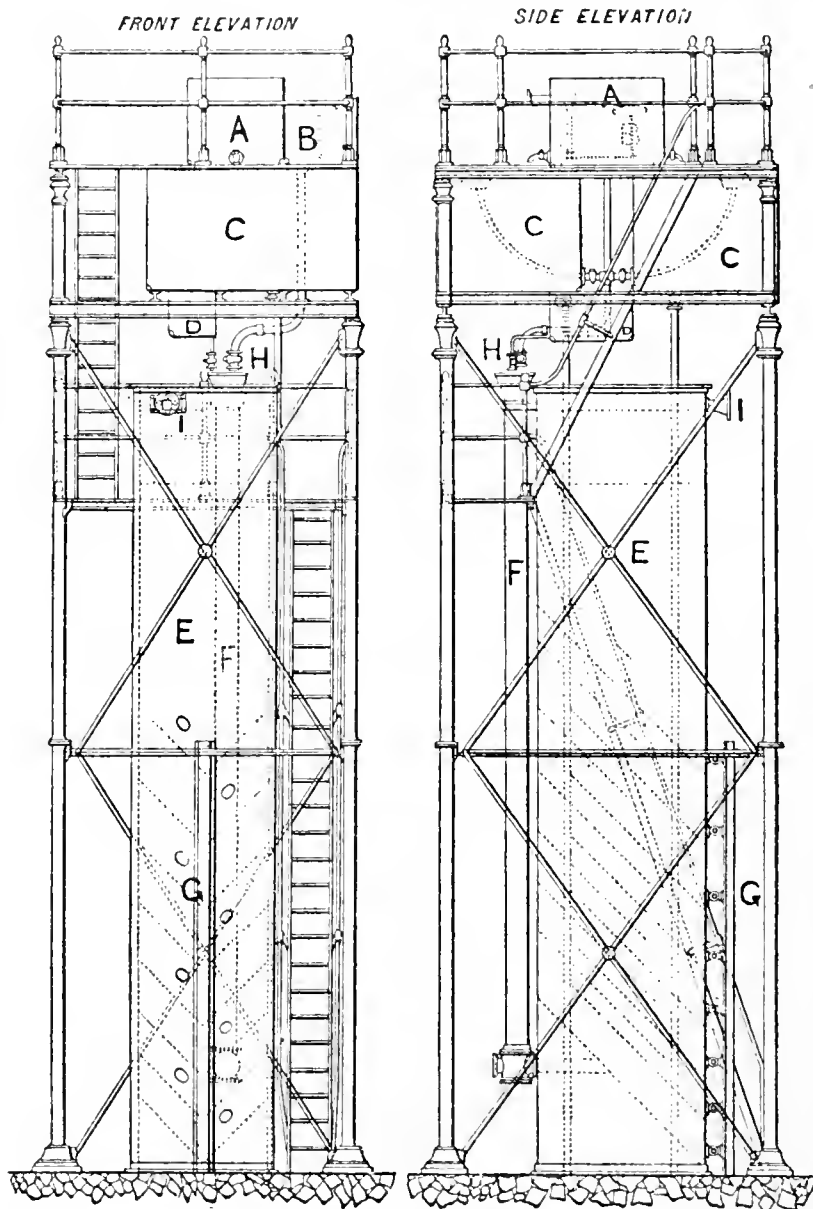
The form of apparatus which has become identified with this method of softening water is the invention of Messrs. Gaillet and Huet, of Lille, and is known here as the Stanhope Purifier, for which the English patents are held by The Stanhope Company, Limited (formerly called Corder, Allen & Co.), of 20, Bucklersbury, London, E.C., to whom we are pleased to record our obligations for many facilities afforded in the preparation of this paper. A few words will suffice to render the salient points of this apparatus intelligible. The principle involved is one of subsidence and decantation, which admits of the separation of all kinds of solid matters in suspension, however flocky or gelatinous. In the annexed drawing the same letters refer to the same parts in both figures.

A is a store tank containing caustic soda solution of 27° B. B is a tank receiving the water to be treated, which is maintained at a constant level by means of a valve and float. C and C are two tanks for use alternately, in which the lime water is prepared, a measured quantity of caustic soda being added at each time of charging, this mixture constituting the reagent. D is a small tank for maintaining a constant head of reagent. E is the clarification tank

in which the decantation is accomplished, and which will presently be referred to in detail. F is a large pipe in which the mixture of water and reagent takes place. G is a pipe in connection with cocks for drawing off the sludge as it accumulates in the angular spaces in the clarification tank. At H are the cocks provided with graduated quadrants for conveniently adjusting the quantities of water and reagent. I is the delivery pipe for the softened water.

serves as a safety filter to stop any particles which have escaped subsidence.

The water supplied to the apparatus at B is conveyed by a pipe to H, where it flows into the mixing pipe along with the reagent from C and D, the quantities being regulated by the cocks at H. The mixture of the water and reagent being effected by falling together into the funnel of the pipe F, precipitation at once commences, and the whole travelling down the pipe enters the clarifi-



THE STANHOPE PURIFIER.

The clarification tank E contains a number of thin diaphragms or shelves of a V shape, inclined at an angle of 45° , as shown by the dotted lines; these are rivetted alternately to the two opposite sides of the tank, and their position forces the water to take a serpentine course through the tank. A bed of wood shavings, contained between wire nettings in positions indicated by the two lines of rivets near the top,

cation tank by a branch pipe near the bottom, whence it rises in a serpentine course to the top, whilst the clear and softened water overflows into the delivery pipe at I. The precipitate on settling out finds its way down the inclined shelves to the angular spaces connected with the sludge cocks, by opening of which the mud is removed without interrupting the process. The whole operation is thus a

continuous one, and the labour involved consists in discharging the precipitate by opening the sludge cocks about once a-day, and in the preparation of the reagent at long intervals. In place of the two line tanks, a simple automatic apparatus is sometimes employed for preparing the lime water continuously.

A horizontal form of apparatus designed on similar principles is also made, giving equally good results, and this arrangement is sometimes more suited to the local surroundings or requirements of special cases.

The precipitate from the sludge cocks forms a mud containing about 20 per cent. of solid matter as a maximum, but taking the average of the sludge as obtained by leaving the cocks open until the accumulation of precipitate has all come away, as can easily be seen in practice, the solid matter amounts to four or five per cent. This can be run straight away or allowed to stand for the superfluous water to drain off, leaving the solid matter for more convenient disposal. The solids of the sludge vary of course greatly in composition, according to the nature of the water undergoing treatment. From some waters almost pure carbonate of lime is obtained, others give in addition hydrate of magnesia, and often small quantities of silica and oxide of iron. Organic and coloured matter is sometimes present to a considerable extent, and the alumina and iron salts then employed also modify the composition and appearance of the sludge. As examples of the latter class the following two analyses will serve. Both samples were dried at 135° C. before analysis :—

	I.	II.
Matter driven off at a red heat ...	48.6%	38.8%
SiO ₂	1.2	17.8
Al ₂ O ₃	1.2	21.3
Fe ₂ O ₃	1.5	7.7
CaO	39.1	7.2
MgO	8.0	3.1
CO ₂ , other acids, etc.	4	4.1
	100.0	100.0

This system of collecting a small amount of precipitate from a large volume of liquid by systematic subsidence offers particular advantages where such precipitate is of a light gelatinous nature, by reason of its admixture with hydrate of magnesia or alumina, or gummy and slimy from presence of much organic matter. Excellent results have been obtained with this apparatus in the treatment of waste water from factories and streams polluted with sewage and dyestuffs.

DISCUSSION.

The CHAIRMAN, after alluding to the value of such communications to those who had experienced the effects of foul waters on their boilers, said that he was by no means sure that living organisms were necessarily injurious to health. It was also necessary to consider what effect such powerful filters would have upon the taste of water, for he believed that many people would prefer water of doubtful purity, but pleasant taste, rather than pure water rendered thoroughly insipid.

Dr. PERCY FRANKLAND regretted that he was not present at the beginning of the paper. While admitting that what they had heard made it quite evident that coke was capable of exerting chemical action on the organic matter and nitrates in water, he thought that it was also clear that this action was due to the iron present in the coke. He had not analysed the coke he used in the experiments which he had already brought before the Society, but it was obvious that it could not have contained much iron, for the water

before and after filtration contained much the same amount of organic matter and nitrates. In fact, he had used it purely as a biological filter. The possibility of making coke a chemical as well as a biological filter, and maintaining its efficiency by means of a battery, was of great practical importance; but he was particularly struck by the experiments on the purification of water by a copper-zinc couple. He was glad to see that the authors had submitted their filters to the test of gelatine-plate cultivation, for no filters which failed to remove micro-organisms could properly be considered filters at all. He would like to know how long the various filters alluded to had been in use before the experiments were made. He was not prepared to agree with the theory that sterilisation was always accompanied by chemical action, and *vice versa*, for he knew domestic filters which were efficient in the reduction of chemical organic matter, but which, when submitted to the gelatine test, showed that they were incapable of touching the micro-organisms present. Bischof seemed to take the view that the gelatine process failed to determine the value of filtration, because filters generally regarded as efficient failed to stand this test; or, in other words, the filter was to be the test of the gelatine process, instead of the process testing the filter. With regard to the zinc-copper couple experiment, he would like to know whether the water operated upon was pure or rendered saline, as that fact would have considerable influence on the micro-organisms. Undoubtedly Messrs. Macnab and Beckett's process effected considerable purification, although his own experiments, made at Mr. Newlands's request, had hardly shown the reduction of the hardness in practice to be quite so great as the figures before them would suggest. This was not to be expected; but he should like to hear whether this process had been tried on the hard water from the chalk underlying the London clay, which contained much carbonate of soda, and was distinctly alkaline. This water was very difficult to treat by Clarke's process, and was quite different from the water at Clyde Wharf, which, though derived from the same stratum, was not alkaline.

Mr. BISCHOF agreed with the authors of the paper that biological testing was still in its infancy. When water was required free from iron, they used a test which indicated the presence or absence of iron; and when softness was required, the water was examined to that end. Why, then, should experimenters not adopt the same principle in testing waters for wholesomeness? Yet there were some who attached no importance to these microphytes and their development. As a rule, Dr. Koch's test was restricted to a mere statement of the number of colonies found, which certainly was not Dr. Koch's intention. Microphytes were only partially shown by the gelatine-peptone process. Storage, again, was a most important factor to consider. Storage and consequent multiplication of germs took place in every domestic filter, and they were in a constant dilemma between rapid, and hence inefficient, filtration, and filtration so slow as practically to become storage. He had known New River water increase from 53 to 770,000 colonies in six days while kept in a sterilised flask. One point had been lost sight of—namely, that the suitable temperature for germ development varied within narrow limits—say, 5° C. To this fact regard must be had in preparing the gelatine mixture, lest, on the one hand, development should cease, or, on the other, the test should fail from liquefaction of the plate. Stress had been laid at times on the different kinds of colonies, but little light had been thrown upon them, even by Dr. Koch. The test still fell far short of perfection. Dr. Klein

had given an instance in which Dr. Koch's gelatine-peptone test indicated only 5000 colonies, when another test indicated 150,000. Now, pathogenic organisms failed to grow in gelatine-peptone, so that it was not at all unlikely that among the 145,000 germs not indicated by that process there might be the very pathogenic organisms they were seeking. Dr. Klein had also often added known pathogenic organisms in measured quantities to samples of water, but had never recovered one-half of them, though he knew in each instance what to look for and how to indicate its presence. Surely, then, this was enough to show that the gelatine-peptone method, *per se*, was no test of the wholesomeness of a water.

Mr. THORP said he hardly liked to speak on the subject, because it was so long since he had done any practical work in water analysis. He would, however, like to ask Mr. Salamon whether the ferro-coke which was digested with hydrochloric acid was the same which had been previously used, or a fresh portion which had not been used for filtration. Mr. Salamon laid great stress on the reduction of the total solids and the total hardness, but he could scarcely understand why, for he supposed that it must be from some chemical action of a kind which could be of very little importance in a filter, since it must come to an end. If he understood Mr. Salamon aright, he considered the activity of a filter to be in direct proportion to the dissimilarity of the two constituents. Did he mean electric dissimilarity, or of what kind? Although without any basis of experiment, he should be inclined to agree with Dr. Percy Frankland that there was no necessary relation between the chemical action of a filter and the removal of living organisms. The filter might remove them without chemical action or it might exert chemical action and not remove them. It might do both or neither. It was possible to attach too much importance to the presence of living organisms in a water, yet although they were not necessarily injurious, yet if they were absent they could not do harm. He would like to express his own opinion that it was not desirable to put too much weight on determinations of individual impurities. In water analysis one wanted the opinion of an experienced analyst. If one consulted a medical man, one wanted his advice based on all the symptoms, not on one. If it were possible he thought it would be desirable even to discontinue the publication of numbers obtained in water analysis. If he had no knowledge of the subject, he thought he should prefer to have merely the opinion of a competent man rather than to have a number of figures placed before him which he could not understand. On this subject more weight attached to the name of the analyst than in almost any other department, while the report of a tyro might be valuable or it might be worth no more than the paper on which it was written.

The CHAIRMAN pointed out with regard to the second paper that the object of the process was to prevent the formation of scale in their boilers, and so long as that object was obtained the exact condition of the waters was a matter of indifference.

Mr. NEWLANDS, in reply to Dr. P. Frankland's statement that the water at Clyde Wharf hardly showed as much improvement as the waters referred to in the paper, stated that though it might not be alkaline, nevertheless it contained much organic matter, and was generally more impure than the samples they had before them. The process was a great improvement on those they had tried before, for it was practically continuous, and the cost for chemicals was only about one penny per thousand gallons.

Mr. SPILLER, while recognising the practical value of attempts, such as those of Messrs. Macnab and

Beckett, to soften and purify water for technical purposes by the combined action of soda and lime, could nevertheless have wished to see a greater difference between the quality of the water before and after treatment than appeared to be the case, judging from the figures before them. He was surprised to see as much as 3·85 grms. of sodium carbonate left, equal to about one-third of the total impurity. Surely this pointed to the use of excessive quantities of reagents, for the sodium carbonate was capable of precipitating a further quantity of calcium and magnesium salts.

Mr. MACNAB, in reply, said the paper referred especially to water of the class mentioned by Dr. Percy Frankland. The difficulty of reducing water to the minimum hardness had been touched upon. In regard to the behaviour of magnesia, it was due to the comparatively large quantity of that substance in the Clyde Wharf water that such good results were not obtained as instanced in the paper. With regard to water containing comparatively large quantities of common salt and carbonate of soda from the London district, they had had no experience, but they had in the laboratory treated waters from the coal measures, which generally contained a notable quantity of carbonate of soda in conjunction with sulphate and carbonate of lime, and from that experience he should have no hesitation in saying that the process was capable of dealing with such water. In many cases the carbonate of soda present was quite sufficient to decompose the sulphate of lime, at any rate with the addition of a very small quantity of caustic soda. With regard to Mr. Spiller's remark about there being a needlessly large quantity of carbonate of soda in the analysis, it would certainly have been better if there were less, but those were entirely technical results, and they did vary a little. Anyone who had any experience of working processes on a large scale would know the difficulty of carrying out reactions to theoretical equivalence. In many cases the analyses showed only one grain of carbonate, and in many others there was no carbonate of soda at all. One could not expect a very large diminution in the total solid matter in the water, because the lime was to a large extent replaced by soda salts.

The CHAIRMAN asked if Mr. Salamon had tried any experiments to prove whether fresh colonies appeared in water which had been passed through filters, as in the case of water passed through purely mechanical filters?

Mr. SALAMON, in reply, said that he must share Dr. Percy Frankland's regret that he was not present at the commencement of the paper, because he had missed the point on which he laid particular stress with respect to his experiments. Dr. Frankland stated, at the time he read his paper, that his filtration experiments were made through six inches of coke in a combustion tube. He had referred to that at the commencement of his paper. If a Winchester quart of water were passed through six inches of coke it was hardly so adequate a filtration as those which he had recorded, and indeed could hardly give any definite result at all. But assuming that there was a result obtained, Dr. Percy Frankland said that coke did sterilise water, but omitted to mention that the amount of water which was passed through that coke in order to assure sterilisation was relatively extremely small—probably not more than 5cc.

Dr. PERCY FRANKLAND said he filtered about a litre for twenty-four hours.

Mr. SALAMON said that he took it that Dr. Frankland passed that amount through six inches of coke, submitted that to chemical analysis, and found no difference whatever. After he had done so, he then

put five inches cc. through those six inches of coke and submitted that to plate cultivation. Naturally the 5cc. were able to be chemically affected, whereas the larger quantity would not, and hence he obtained sterilisation in the small sample and no chemical change in the large. It was to be regretted that he did not test the coke for iron, for he himself had always found it present.

Professor BISCHOF said it was generally as sulphide of iron.

Mr. SALAMON said it was iron in some form or other. With regard to the copper-zinc couple, the experiment was not made for drinking or commercial purposes, but was meant to possess a purely theoretical interest and to support their theory. At the same time no zinc or copper was found in the filtered water, and no saline matter was introduced into the water. It was an ordinary sample of water. All the filtrations referred to on the tables were made after the water passed through once—i.e., the filters were not kept for any length of time. In answer to the Chairman, they would extend their investigations to see whether the water was absolutely sterilised by filtration, and if the removal of organic impurities really rendered it incapable of further contamination by germs. With respect to sterilisation taking place without accompanying chemical action, he thought it was a question still to be proved. So far as their experience carried them, those experiments which Dr. Percy Frankland brought forward where he found sterilisation accompanied by purification, they accepted at once; but what required further elucidation, was the statement that micro-organisms might be destroyed without a corresponding chemical purification of the water. In the Pasteur and Chamberland filter all organisms were, no doubt, removed, but there was no proof of their death.

Dr. BISCHOF said it could easily be proved by taking some filtering material, mixing it up with the sterilised water, and then testing it.

Mr. SALAMON said as a matter of fact it was just as correct to assume they were mechanically removed (as in the case of cotton wool) as that they were killed. With respect to the ferro-coke, that which was washed with hydrochloric acid was previously used, and represented that concentrated ferro-coke which gave the excellent purification in the first instance. He must apologise for not having further insisted on that point, because it was the very essence of the experiments that they found purification in the case of ferro-coke when it contained a large amount of iron, and after it was treated with acid and digested for a long time that purifying power ceased. With respect to the hardness, the reason he laid some stress upon that was that the spongy iron experiments effected a very considerable diminution in the hardness. That was noticed also in the experiments with coke, ferro-coke and the copper-zinc couple, and they wanted to find out to what that diminution of hardness was due. They, therefore, purposely made one sample of water artificially strong in temporary hardness, and then added ferric hydrate to it, which produced the remarkable effect shown on the table.

Mr. BISCHOF asked how it acted?

Mr. SALAMON: Probably by decomposing the acid carbonate of lime. Of course ferric hydrate could not exist as such in coke, yet it would be seen on reflection how much it bore on this experiment.

Mr. JOHNSON said that he had made experiments on a large scale with ferric hydrate, and found it to have a strong attraction for lime salts, and when in small quantities it removed them.

Liverpool Section.

Chairman: E. K. Muspratt.

Vice-Chairman: Prof. J. Campbell Brown.

Committee:

Eustace Carey.	A. Norman Tate.
John Hargreaves.	J. Affleck.
E. Milner.	J. C. Gamble.
C. Symes.	Douglas Herman.
F. Hurter.	Alexander Watt.
H. Brunner.	E. G. Ballard.

Local Sec.: W. P. Thompson, 6, Lord Street, Liverpool.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held Wednesday, May 5, 1886, at
University College, Ashton Street.

DR. J. CAMPBELL BROWN IN THE CHAIR.

WOOD AS A PAPER-MAKING MATERIAL.

BY T. ANDERSON REID.

The necessity for crude vegetable fibres for paper-making occasioned by the demand for cheap literature of all kinds has led British paper-makers within recent years to again turn their attention to materials which at one time were considered hardly suitable or too costly to work economically. It is well known to you that formerly rags were the staple raw material of the paper trade. Science and necessity suggested straw, esparto and wood. Esparto is now the chief raw fibre for paper-making, having been introduced for that purpose by Mr. Roulledge thirty-four years ago. It did not come into general use until 1861.

According to Stonhill, the imports of this grass in 1884 amounted to 184,682 tons of a declared value of £1,128,000.

Wood is sharing the same fate as esparto did prior to 1861, and I think it is only a question of time when the paper trade will use it largely. The idea of substituting wood for the other fibres used for paper-making is claimed by several, but I think as far as this country is concerned the credit should be given to Houghton.

In 1856, whilst engaged as a workman boiling esparto grass at a paper mill in Gloucestershire, he had occasion to place a wooden wedge in contact with the alkaline solution in the boiler, and on the boiling being completed he was surprised to find that the wood had become partly disintegrated; subsequently he found that by treating wood with stronger alkaline solution, assisted by increased steam pressure, wood became as tractable as straw or esparto. The process has not met with that consideration in this country which it merits, due in a great measure to our want and appreciation of those scientific principles that are necessary in treating refractory raw material. I may add that quite recently considerable impetus has been given to the question of pulping wood.

For the purpose of the paper-maker, straw, esparto and wood may be structurally assumed to be alike, the three being made up of fibres of cellulose coated more or less with encrusting matters of various kinds.

In straw, silica forms the chief component of the encrusting matter; in wood the fibres are indurated with the material of the fibre wall which has undergone change in the process of growth.

Again, they react with acids and alkalis much the same. For instance, the fibres of straw and esparto may be separated by digesting with solutions of

caustic soda at a steam pressure of 35lb. per square inch, equal to a temperature of 260° F.

Ordinary woods require more soda than the grasses, and pressures varying from 100 to 120lb. per square inch, or in Fahrenheit degrees from 328 to 340. The hardest woods—i.e., sycamore and lignum-vitæ—require, again, very high pressure, 200 to 250lb., but as these are never used for fibre-making, they require no further notice.

Acids have more or less chemical action upon the non-cellulosic constituents of wood, depending upon the nature and strength of the acid used. Nitric acid has been employed industrially for treating wood, but the cost of the acid, and the difficulty of finding plant to withstand its action, have caused it to be discarded; there was also the danger of forming nitro compounds with the cellulose itself.

A solution of sulphur dioxide in water, with or without a sulphite of an alkali or alkaline earth, has, however, found the most favour with chemists. First patented by Tilgmann in 1866, it has since formed the subject of many patents, only differing from the original in matters of detail. It is said that the cellulose obtained by treating wood by any of the various sulphite processes is not nearly so pure as that made by the soda process, and from the nature of things this appears to be quite rational.

For paper-making, wood is treated by two general methods, depending upon what kind of paper it is to be used for: 1st, Mechanical wood-pulp; 2nd, Chemical wood-pulp.

Mechanical wood-pulp is produced by simply rasping wood by suitable machinery in contact with a stream of water. By this means the fibres are teased out and are not deprived of any of the constituents eliminated by chemical treatment. Such pulp comes largely from Sweden and Norway, where the raw material wood abounds, together with an abundance of water. I will here state that mechanical wood-pulp is used only for inferior papers. The material of card-board sample boxes are almost entirely wood-pulp of this description. Many of the Swedish mechanical pulps can hardly be detected by the eye from unbleached chemical pulp; a rough though reliable test consists in igniting a small portion of each pulp and noting the odour of the smoke. Mechanical pulp gives an odour resembling burning wood. Chemical pulp, on the other hand, when treated as above, smells like smouldering cotton wool.

As chemical wood-pulp is the only form in which wood can be applied to the manufacture of the better classes of paper, I will now give you an outline of the various operations involved in the conversion of the wood into pulp by the soda or alkaline process, as this is the only process which up to the present has yielded a nearly pure cellulose from wood, together with the advantage that iron may be used for the boilers, and also that a large percentage of the soda is recoverable.

The question naturally arises, Which are the best woods to use with due regard to quality and yield of fibre? The hard woods, such as beech and birch, yield a higher percentage of fibre than the soft woods. Again, they have the advantage of being denser, consequently a much larger quantity can be worked in a given time, or what is much the same, a boiler will hold a heavier charge. The fibre from them, however, is very short, and where length of fibre is of primary importance, soft woods are preferred; the soft woods generally are found to give also a good percentage of cellulose.

The table below will give an idea of the woods that experience has shown are best adapted to meet the requirements of the pulp maker, and, if care

fully treated, they give a first-class cellulose. A medium fibre may be obtained by working a mixture of two-thirds hard wood and one-third soft wood, or by using poplar; this, although a soft wood, does not possess a long fibre.

WOOD.	Class.	Cellulose or Fibre per cent.	Class of Fibre.
Beech.....	Hard	38.5	Short
Birch	"	42.0	"
Hemlock	Soft	37.5	Long
Poplar	"	41.0	Medium
Scotch Fir	"	39.0	Long
Spruce Fir	"	38.0	"

Before wood can be treated chemically it is requisite that it be broken up, so that the disintegrating fluid may act uniformly upon it. If round timber is being worked, it is necessary to remove every trace of outer bark, as this would make the pulp specky. After barking, the wood is sawn into slabs about the size of ordinary railway sleepers. These, in their turn, are fed obliquely against the "chopper," a heavy revolving wheel, on the periphery of which there are steel cutting knives. The chopped wood is now crushed in a mill constructed after the style of an ordinary coffee-mill, and, by this treatment, the knots get broken, and the wood offers a large surface for the action of the boiling fluid. I may here mention that bamboo canes are also used for making a very high-class fibre. In these, the knotty nodes are cut out preparatory to crushing, as they do not digest well. In preparing wood for the various sulphite processes, I understand that the knots have to be cut out, as they will not soften on boiling. This is a great disadvantage, and must add considerably to the cost of the preliminary preparation, if it does not altogether exclude very knotty wood.

The mechanically-prepared wood is now ready for digesting. The digesters for the alkaline process are mostly vertical wrought-iron cylinders, 20ft. high by 4½ft. diameter, made strong enough to carry 200lb. steam pressure. They have a man-hole at the top for filling, and a sluice valve at the bottom for emptying. About a foot from the bottom, and inside, there is a perforated false bottom, covered with strong iron gauze; there is also a pipe for admitting the alkaline liquor, and another at the lowest point of the digester for blowing off the spent solution. The digesters are generally heated by steam blown in from a separate steam generator. Some digesters are also supplied with a vomit-pipe for vomiting the wood, as it is termed. The vomit-pipe consists of a perforated ring of piping placed underneath the man-hole of the digester. Two vertical pipes are let into the ring, and the free ends of these are placed underneath the false bottom. The steam pipe from the generator comes below the extremity of one of the vertical pipes, and when steam is admitted it forces the liquor up the pipe into the perforated ring, through the holes of which the liquor showers over the wood. As the vomiting takes place during the filling of the digester, it should not be unduly prolonged, otherwise the liquor will be diluted below the boiling strength by the condensed steam. A better arrangement, and one less complicated, consists in fitting the end of the liquor-pipe—which of course should enter the neck of the digester—with a rose, similar to that of an ordinary watering-can. Some woods, particularly the fir tribe, cannot

be vomited, owing to the large amount of resinous matter they contain, which cause them when so treated to froth over.

For digesting wood, there is no doubt that dry heat would be much preferable to live steam. Good results have been obtained by placing a serpentine coil below the false bottom, and allowing steam to circulate through the coil. The condensed water is taken off by an ejector, or valve, placed on the exit end of the coil. There are several advantages attending this mode of heating. 1st. No steam from the generator comes in contact with the contents of digesters, consequently there is no risk of the wood being underboiled by undue dilution of the soda liquor. 2nd. The spent liquor is less dilute, therefore less fuel is required for recovery. 3rd. If the digesters are covered with a good non-conducting medium, the steam may be shut off from the coil when the requisite pressure is attained, and the digestion will proceed without any further application of heat until the close of the operation, as the only heat leaving is what escapes by radiation. 4th. The generator may be turned on to freshly-charged digesters without any risk of the alkaline liquor backing from the digesters into the generator, due to differences of pressure and leaky valves.

Paper-makers seem to be divided in opinion as to which are the best conditions for digesting wood. The majority of them advocate a large excess of caustic soda. Experiment has shown that wood can be completely dissolved by very strong alkaline solutions, aided by high temperature. The idea of a necessity for large excesses of caustic alkali has no doubt arisen from the fact that sometimes the wood is not digested when boiled with apparently the same percentage of soda, but I think the bad boiling-sometimes found could be traced to the causes just mentioned above, where neglect of the workman in attending to the various stages of the boiling would throw the job wholly adrift. For this reason I have advocated the dry-heat method as one which leaves less loopholes for excuse, as a tell-tale gauge would say if the pressure had been sufficient. Again, too little soda or under-pressure does not digest the wood, or only partly so. Economising soda by using extra pressure chars the cellulose, and requires more bleach to bring it up to colour, with the result that the quality of the fibre suffers. Such drastic modes of treatment injure the fibre, and causes the yield to be low. Doubtless this has given rise to the prejudice which is entertained against the soda process by some writers. Assuming that dry heat is decided upon for digesting, 20 per cent. of 70 per cent. caustic on the dry wood, and a pressure of 120lb. per square inch (=340° F.), gives excellent results. The solution of sodium hydrate used for boiling should be as nearly completely caustic as possible. The digester is filled with the mechanically-prepared wood, and this is nearly covered with the alkaline liquor. The cover is put on and bolted down, all other connections being also closed. All being right, steam is turned in, and when the pressure on the digester shows 120lb. it is kept at this for two hours. Steam may then be shut off, and the spent liquor blown out. The wood, if properly digested, should be completely softened, but still retain the form of the original chips.

After the spent liquor is off it is usual to cover the pulp with warm water; the sluice valve at the bottom of the digester is opened, and the stuff washed into wooden drainers with false bottoms of perforated zinc plates.

The next operation consists in washing the pulp free from alkali, and for this purpose the stuff is thrown into an ordinary pulp-washing engine, and a good supply of water kept running until the water

passing through the drum is clear. After this operation the pulp is ready for mixing with other unbleached fibres, such as esparto, straw, or rag fibre, and paper made from the mixture in the usual way. Assuming, however, that the pulp is being made independent of paper-making, after washing, about 20 gallons of bleach solution at 7° Tw. are added to it in the washing engine. This removes the plum-coloured tint common to pulp made from hard wood. Finally it is run from the washing engine over a paper machine and made into sheets, which, in their turn, are packed into bales averaging about 4cwt. each. The baled pulp contains half its weight, or 50 per cent. moisture.

The next important point calling for consideration in the alkaline process is the recovery of the soda from the spent alkaline liquor blown off from the digested wood. The first liquor (that is, the one blown off from the wood) is only worked, as it does not pay for fuel to work the weaker washes obtained. This first liquor averages from 18 to 20° Tw., and represents 90 per cent. of the soda originally employed. It contains about 80 per cent. water, together with matters extracted from the wood, organic and mineral. The process at present pursued is very simple, consisting in boiling down until free from water, and subsequent calcination to burn out organic matters. By this treatment a crude sodium carbonate is obtained, containing from 50 to 53 per cent. alkali Na_2O . There is also present a little free carbon, together with sulphate and sulphide of sodium.

The resulting ash is dissolved in water, and adjusted to about 20° Tw., and causticised with lime in the usual way. The caustic liquor obtained is used for digesting fresh batches of wood, the loss of soda being made up by addition of solid sodium hydrate.

By the foregoing system of recovery, the organic constituents of the spent liquor are lost, being for the most part burnt into carbon dioxide and water. A more rational process would be to run the spent liquor, after being deprived of water, into a retort or still, and distil it destructively at the lowest available temperature. By this means a distillate would be obtained containing acetic acid, methyl alcohol, and the other bodies present from the distillation of woody tissue. It is a point open to experiment if oxalates, and, indirectly, oxalic acid, could not be built up (by proper treatment) from the desiccated liquor. Experiments made in the laboratory upon the destructive distillation of the dry residue from the spent liquor gave promising results.

By the calcination system of recovery, about 80 per cent. of the soda is recovered for use, and this may be set down as reducing the cost of the soda by about 50 per cent. The question of how does wood fibre compare in cost of manufacture with the other crude paper-making fibres, may be answered by putting down the relative cost of pulp made from wood and esparto grass respectively. Wood yields about one third of its weight of fibre. Good esparto is said to yield half its weight.

PULP FROM WOOD.

Basis $\frac{1}{2}$ or 33·3 per cent. yield.

	£	s.	d.
Three tons wood, say 25/- per ton.....	3	15	0
Mechanical treatment, say 7·6 per ton....	1	2	6
Caustic for digesting 25% of 70 . at, say 10s. per cwt.....	7	10	0
Washing and bleaching, say 5/- per ton ..	0	15	0
	13	2	6
Add 20% for exigencies	2	12	6
	15	15	0
Less 50% net of soda used	3	15	0
Cost per ton fibre	£12	0	0

PULP FROM ESPARTO.

	Yield, 30 .	£	s.	d.
Two tons esparto, say £6 per ton		12	0	0
Mechanical treatment, say 5 $\frac{1}{2}$ per ton		0	10	0
Soda as above, 10		2	0	0
Washing, bleaching, etc., say 3 per ton ..		0	6	0
		14	16	0
Add 10, for exigencies		1	9	7
		16	5	7
Less 50, net soda used		1	0	0
		£15	5	7

It has been already mentioned that aqueous solutions of sulphur dioxide disintegrate wood, liberating the cellulosic tissue. Processes based on this reaction are now receiving a good deal of attention industrially. I will therefore make a few brief remarks on the sulphite or acid process of treating wood. There is no doubt that for certain classes of paper, sulphite pulp forms a valuable addition to the paper stock. Those best qualified to speak—viz., paper-makers of long standing—say that white paper cannot be made from pulp of this kind. Again, published quotations show the prices of soda and sulphite pulps to be much the same.

Practically, the great objection to the employment of acid solutions for disintegrating wood is that iron vessels cannot be used unless well protected internally by some metal upon which the solution has little or no action. Lead is used with more or less success for the above purpose. Copper, by the way, has a low solubility in acid sulphites, even at high temperatures, and a vessel of copper need not be so heavy as one of iron for a given pressure.

The time necessary to pulpify wood by the sulphite process is very much greater than by the soda method, and this must tell against the cost per ton for fuel, labour, etc. The wood, again, as previously mentioned, has to be very carefully prepared mechanically, due regard being paid to the exclusion of knots. In fact, the sulphite process, taken as a whole, is much more complicated in matter of detail than the soda process, and time has yet to show the financial advantages of the acid system of digesting wood over that of the older alkaline process. No doubt experience and experiment will remove many of the difficulties that are now found in connection with the former system.

Before concluding this paper, I may mention a few facts in connection with the utilising of waste wood, such as the chips, etc., produced in Liverpool saw-mills, and that of our Widnes and St. Helens chemical works. Much of the above-named stuff requires no further mechanical preparation than crushing to suit it for making a tolerably good paper fibre. The objection raised to the waste so made might be that any individual mill or works would not form enough to keep a moderate sized pulp plant going. This could be met by collecting the waste to one centre, there to be pulped. If the process were carried on in conjunction with Leblanc alkali making, a further advantage would accrue from the fact that the liquor used for digesting could be obtained direct from the causticiser; consequently the alkali would not cost the same as finished soda ash or caustic. No special recovery plant would be requisite, with the exception of furnace and storage tanks, as the recovered ash could be worked with the Leblanc black-ash into liquor.

In conclusion, I would mention to those who may feel disposed to follow out the problem of pulping wood, that they can obtain a deal of useful knowledge on the subject by perusal of the Prize Essays in Forest Products, published by the Committee of the Edinburgh International Forestry Exhibition.

A NOTE ON MR. WESTMORELAND'S PAPER ON THE WET ASSAY AND COMMERCIAL VALUATION OF COPPER ORES.

BY JOHN INNES,

Member of the Society of Arts, Fellow of the Chemical Society, etc.

HAVING recently read in the February number of the Journal the very interesting and generally accurate paper by Mr. J. W. Westmoreland, I venture to make one or two remarks on the important subject he deals with.

While fully agreeing with the proposition that a wet assay more accurately represents the copper in an ore, I think it is pretty generally admitted that the dry method tells the smelter more nearly what he may expect to get out. The author proposes to assimilate, for the purpose of valuation, the wet and dry produces by introducing a scale of variations, so that one assay might practically give the purchaser both a wet and a dry produce. Thus a pyrites of 3 $\frac{1}{2}$ to 4 per cent. wet would be called 2 $\frac{1}{2}$ to 3 dry, the variation or margin being 1 per cent., which, no doubt, is a fair allowance. There is a serious, if not a fatal, objection to this suggestion. For example, if a sulphide and a chloride each gave 4 per cent. wet, Mr. Westmoreland would equally reduce both to 3 per cent. dry by his process of margins. A dry assay would show the chloride to have a lower percentage than the sulphide; in other words, there would be a loss in the furnace when the chloride was assayed, which would roughly indicate the smelting loss on the bulk. The suggested scheme makes no provision for such a contingency.

In the commercial section of the paper, the reader is told several times that purchases are compared with ore of 8 $\frac{1}{2}$ per cent., that the standard is the standard for 8 $\frac{1}{2}$. As a fact, the standard is always compared or adjusted to 9 per cent. produce.

At Cornish ticketings a standard is certainly made out at a nominal R.C. of 55s., which standard generally appears in the newspapers; but another is always calculated on a R.C. for 9, which varies according to the position of the mines and port of shipment. If the produce of the sale be not 9, the standard is altered by a fixed sum for every produce, which practically is a V.R.C., as stated by Mr. Westmoreland.

The standard at Swansea ticketings is made up at a fixed R.C. for 9, and subsequently adjusted, as in Cornwall, to the produce of the sale, the difference being really an altering of the returning charge.

On page 60 a short paragraph appears in italics, which especially calls for comment:—

"It must be most distinctly understood that the standard is calculated from the prices paid for copper ores, and not the reverse."

Dr. Percy says much the same thing. As a matter of fact, buyers very generally, if not always, base their offers on a certain "standard for 9." At ticketings they vary their successive tickets, up or down, as the evident demand, quality of the ore, etc., indicate. They then deduce an average standard for 9 from the prices of the several lots. Thus, although the standard is calculated from the prices as per Mr. Westmoreland's italicised paragraph, the prices have first been based on the standard. Vivian's scale is now beginning to come into use; the standard is giving way to the "unit." To anyone who has given attention to the "ticketing" system, the wonder is not that it is dying out, but that it has lasted so long.

DISCUSSION.

MR. WESTMORELAND said that the margin referred to by Mr. Innes—namely, 1 per cent. on $3\frac{1}{2}$ to 4 per cent. wet produce—referred to pyrites only; but the difficulty was very easily met, for ores containing chlorides could be calcined, and the wet assay made on the calcined ore. In making dry assays of this class of material, the ore was generally roasted to expel chlorides before the fusion for regulus, for if this was not done most of the copper present as chloride passed into the regulus. He could not agree with Mr. Innes, that it was pretty generally admitted "that the dry assay told the smelter more nearly what he may expect to get out" of the ore, and none of the speakers at the discussion on his (Mr. Westmoreland's) paper had taken that line of defence. It was generally admitted that the smelter did get out more copper than the dry assay indicated; moreover, he had special information which confirmed his statement on this matter. His objections to the dry assay were based on the serious variations of duplicate assays, and the unreliability of the process in the hands of experienced operators, and he would ask which of the undermentioned dry assay products should be taken as "representing to the smelter the yield he may expect to get out":—

					Settled.
(a)	224	33	334	35	344
(b)	59	584	—	—	614
(c)	76	—	764	—	744
(d)	104	—	114	—	12
(e)	694	694	704	—	694

The above results, which were obtained by experienced assayers, were so extremely variable that they could not give any indication of the furnace produce. His suggestion to use the wet assay as a basis would enable exact and accurate results to be used for valuing copper products in place of the rough and unreliable results he had quoted.

Mr. Innes had misunderstood his statement regarding the standard; his reference to $8\frac{3}{4}$ per cent. produce was that 45s. was the R.C. for this produce only, when computing the standard which was used as a basis for the valuation of cupreous pyrites. He agreed with Mr. Innes that the valuation of copper in ores "per unit" was more satisfactory than the ticketing system.



*Meeting held Wednesday, April 7, 1886, at
University College, Ashton Street.*

THE PRESIDENT IN THE CHAIR.

DISCUSSION ON THE PAPER OF MR. J. W.
WESTMORELAND ON "THE DETERMINA-
TION AND VALUATION OF COPPER IN
ORES AND PRODUCTS FOR COMMERCIAL
PURPOSES, WITH SOME REMARKS ON
THE ASSAY OF GOLD IN BAR COPPER."

THE CHAIRMAN said that although the paper had been originally read before the London Section, yet it was of interest to Liverpool, inasmuch as they had there more to do with the purchase and assay of copper than any other place, excepting Swansea. There were really two questions involved in the paper—one, that of practical sampling and moisture estimation; the other, that of chemical analysis. There were many present well qualified to deal with the question from both points of view, and the meeting would be glad to hear their remarks.

DR. WATSON wished that there had been somebody present to say a word in defence of the Cornish assayers, with whom the author had dealt hardly. They had, in his opinion, proved themselves by no means unreliable in the assaying of copper; they had also been the mainstay of the copper trade as regarded buying and selling. Those who had had opportunities of comparing the results of these dry assayers with those obtained in other ways, could all speak strongly as to their reliability. The author has suggested that they should agree to buy copper on the basis of the product by wet assay rather than by dry assay. It would make little difference to copper smelters who understood their business what basis was used, and the time of transition would prove one of great inconvenience, and even loss, to those who had the sale of copper ores. The author had gone some way to point out anomalies in the present methods, but he had hardly made out a case strong enough to induce them to leave the old Cornish system for one based on the actual contents of copper ores. At the same time, he entirely agreed with the author's estimate of the accuracy of the iodide process. It was in daily use in his laboratory for all estimations of copper. He was distinctly opposed to the establishment of standard international methods of analysis. He would leave a choice of methods to the analyst, being assured that the trade would soon determine for itself whether the results had been properly obtained.

Mr. RAWSON said he did not wish to enter into the discussion of the Cornish assay mentioned by Dr. Watson, but to confine himself more especially to the chemical side of the question as regarded the actual wet assays of copper ores, and to compare methods used by himself with those mentioned by Mr. Westmoreland in his valuable paper. As regarded the moisture, though they did not employ such a primitive method as making the ore red hot for a few minutes, whereby arsenic as well as other volatile constituents, together with water, must be driven off, they used to heat the ore, taking 1lb. of it in a pan over a Fletcher's burner with the gas turned down. The pan and its contents were then weighed, and the drying was repeated for a shorter time, and again weighed. If the second weighing agreed closely enough with the first, the difference between the second weighings and the original weight was taken as the moisture. Of course he did not consider that this process was of anything like scientific accuracy, though he did think that it gave results with a sufficiently close approximation to the truth for all ordinary manufacturing purposes. Still, however, there was here room for improvement, and he quite agreed with Mr. Westmoreland that the matter was one worthy of further inquiry. Then, as regarded the method of testing green ores for copper, the cyanide process, in which Mr. Westmoreland was evidently by no means a believer, gave, it seemed to him, very good results, if proper care was taken, the process he used being this: A certain weight of the ore was dissolved in nitric acid and evaporated down with sulphuric acid, and then dissolved in hot water, filtering off any insoluble residue. A solution of sodic thiosulphate was then added, whereby the copper was precipitated as cuprous sulphide; this was filtered off, dried and ignited and dissolved in nitric acid, and the excess of nitric acid got rid of by evaporation. The cupric nitrate was then dissolved in a known volume of hot water, and a known amount of ammonia added. A weighed piece of pure electrolytic copper was then taken, weighing about as much as the copper present in the amount of green ore used for analysis, dissolved in nitric acid, the excess of which was evaporated off and then the same known

volumes of water and ammonia were added. They had then two solutions containing about the same amount of copper, the amount in one being known and the other unknown, and the same volume of water and ammonia in each. It now only remained to titrate the two solutions in such a way that they should both be done at the same time. As the blue colour, on the addition of cyanide, did not at once disappear, but first passed through a pink stage, it was as well to filter a part of each solution, towards the end of the operation, into a test tube, and on looking down through the column of liquid it could be at once seen whether there was any colour remaining. It was especially necessary to have about the same amount of copper, the same volume of water and of ammonia in each, and that the titrations should be completed in the same time, in order to get thoroughly satisfactory results. Any lead present was mainly got rid of by the evaporation with sulphuric acid, and even if it were present at the final titration, Dr. Steinbeck states, and some experiments of his own bore this out, that it had no effect whatever on the amount of cyanide used. The presence of zinc, of course, would be very prejudicial, but then this was not precipitated by the hyposulphite, or rather thio-sulphate of soda; any arsenic was also volatilised by the ignition of the Cu_2S previous to its dissolving in nitric acid. Hence he was inclined to think that the process was quite trustworthy, provided that the precautions already mentioned were carefully followed. If Mr. Westmoreland had used the method with these improvements, which were well known in works, he was surprised that he was not satisfied with it; if, however, he had not done so, he thought he would probably think of it much more highly if he adopted the precautions here indicated. Mr. Westmoreland further stated in his paper that he had come across differences of 25 per cent. between chemists who used this method; he could only say that he was unable to recall to mind such a discrepancy as this, 15 per cent. being about the maximum in his experience, and in most cases the results were far more favourable even than this. Now, as regarded the testing of copper precipitates; as before, the weighed quantity was dissolved in nitric acid and evaporated down twice with sulphuric acid, and then filtered, thio-sulphate was added, and the cuprous sulphide filtered off and dried, and then mixed with sulphur and ignited in a hydrogen crucible in a current of hydrogen, allowed to cool, and weighed. The lead, which was usually from 50 to 100 per cent., was almost all removed by the evaporation with sulphuric acid, but if there should be any left it would be so little as not to exert any appreciable influence on the results. He had used this method many times, and had always found it to be an accurate one. This he had proved by assaying the same sample over more than once, and also by the general run of the numerous analyses which had been made, and which had been checked by this and other methods. He had, however, never been able to make much out of the electro-deposition method: his own results with it he felt could never be thoroughly depended upon, being sometimes too high and sometimes too low for no assignable reason that he could discover. Some little time ago, moreover, before he heard that Mr. Westmoreland was going to read a paper, he caused two students to make some tests, by the electrolytic method, of an ore which had been determined by the cyanide process. The first one got his results as high as 27.77 per cent. copper, whilst the other student, whose work, though he had no special knowledge of this mode of analysis, was usually exceedingly accurate, only found some 21.20 per cent. copper. The cyanide results gave 24.70 per cent. copper, which, as they

would observe, was a very fair mean between the two. As however this method was used in America, and as Mr. Westmoreland approved of it, he should be glad to hear why it had given such indifferent results in his hands. He fancied that in this method, as in so many others, there would be certain conditions which must be strictly acted upon, and without variation, to get consecutive concordant results. He quite agreed with the author when he said that roasting the precipitated copper in a muffle was not a reliable way; estimations which he had made by it himself, and also his own figures by the subsulphide process, compared with those given by the users of this method, had satisfied him that it was not good. Mr. Westmoreland stated that he had known cases where the ore had simply been dissolved in nitric acid and excess of ammonia added, and the ammoniacal liquid titrated there and then with standard cyanide, the results obtained in this way being sent in as accurate assays. He did not see how such a method could give anything but approximate percentages. It was, however, very useful, owing to the speed with which estimations could roughly be made of the amount of copper in it. It would never do, however, to buy or sell on such an analysis, as the results were from about $\frac{1}{4}$ to $\frac{3}{4}$ per cent. too low, according to the amount of copper present in the sample.

Mr. A. G. PHILLIPS said that with regard to the question of moisture, he thought the present method, carried out in a pan, was sufficiently accurate for all practical purposes. It was, however, possible that discrepancies might arise where the assayer dried his sample at a higher or lower temperature than that used in estimating moisture, and it had been suggested—and with regard to more valuable ores, such as silver, the suggestion had been carried out—that four or five samples should be dried, and the dry material actually bottled in the presence of the samplers and forwarded to the assayers to be assayed without further drying. In that case if any water was left in the sample it would be to the advantage of one party, but at the same time the assay would be proportionately in favour of the other party. This seemed to be the only way to get rid of the difficulty which at present existed. Mr. Westmoreland's remarks pointed to a suggestion that some arrangement might be made for drying at a fixed temperature, but he did not think that would do, because some ores required drying at a much higher temperature than others. With regard to the wet processes for the estimation of copper, he thought they might concede that the process Mr. Westmoreland so strongly advocated (the iodide process) was an exceedingly accurate one, as was also the cyanide process for low produce ores, if properly carried out. Then there was the electro-deposition method, and also that of weighing the copper as subsulphide after ignition in a current of hydrogen, so that practically they had three or four accurate methods for estimating copper. The great gist of Mr. Westmoreland's paper seemed to be an attack upon the Cornish method, and he spoke as if it were comparable to the chemical methods for ascertaining the copper in an ore, but it was never intended for that, but was merely a method for ascertaining commercial value, the original idea apparently being to make the assay by carrying out on a small scale in the laboratory, the same operations as would afterwards be employed in smelting the ore. In this way the amount arrived at would be, not the actual contents of any ore, but the amount recoverable by the smelter after allowing for loss in course of working. Mr. Westmoreland seemed to treat the matter as if those buying and selling by the Cornish assay were under the impression that they were buying or selling the

exact amounts indicated by the assay, but this was not the case, as everyone in the trade perfectly understood the differences existing between wet and dry assays: it would be a very difficult thing if they swept away the dry assay to arrive at a scale of allowances which would be satisfactory for ores of various produces. If they began sweeping away all those old land-marks, the best way probably would be to buy on the wet assay, making the necessary allowances by a difference in the price per unit. Mr. Westmoreland had gathered together a number of examples of bad results by the Cornish method, where there had been great discrepancies. Having, however, been for some time assistant to one of the Cornish assayers, Mr. Westmoreland had had every opportunity for collecting such results, and it probably took him a considerable time to collect such a number of unsatisfactory ones. The next portion of the paper was extremely interesting with regard to the calculation of the "standards" and the deduction of prices from them, but that was chiefly of historical value, because the Swansea sales had practically ceased to take place, and he believed it was now almost the invariable custom to buy and sell by private sale at so much per unit, and the old arrangement of the "standard" was practically obsolete.

Dr. HURTER: Mr. Westmoreland said in his concluding remarks that the discrepancies he pointed out were due in most cases to "careless work and the use of inaccurate methods," and in a very minor degree to "errors of sampling." But the only manner in which his employers lost money was not by the discrepancies in the Cornish assays, but by errors of sampling. In days gone by, sampling was carried out in a very careless manner. One man was sent by the seller and one by the buyer. The seller's agent tried to pick the richest and the other the poorest pieces of ore, thus samples were got which did not represent fairly the whole parcel of ore. It appeared to him that Mr. Westmoreland had not taken into consideration the circumstances under which the moisture had to be determined. Samples were taken and moisture determined at the spot where the cargo was discharged, often in places where the accessories of a well-appointed laboratory were not at hand. It would certainly be the simplest plan if the determination of moisture could be abandoned, and the copper determined in the moist sample, as the last speaker (Mr. Phillips) had pointed out. But his experience was that pulverising a sample altered its moisture, and as the assayer had to reduce the sample to a fine powder that plan could not safely be adopted. He heard one gentleman express an opinion that Mr. Westmoreland's paper struck a blow at Professor Lunge's proposition of international methods of sampling and testing. He did not think that was so. On the contrary, it appeared to him that the paper, by pointing out serious discrepancies arising from the uses of different methods, supported Dr. Lunge's position. As regards the Cornish assay, that, of course, would not be looked upon as a scientific method of ascertaining the exact amount of copper a sample contained. It was simply a method of ascertaining the value of a certain ore, and taken in conjunction with the system of "returning charges" it was a method which gave different values to each unit for ores of different percentages, although the standard price of the unit was fixed. The Cornish assay was in the copper trade the same thing as the English degree to the alkali trade. Neither of them represented the theoretical amounts; both of them were only used for the valuation of the articles in question. Otherwise he thought Mr. Westmoreland's paper very valuable and in-

teresting. It would, perhaps, have been better if Mr. Westmoreland had given a few comparisons of the iodide process with the cyanide process, both carried out in the same laboratory, but he had no doubt Mr. Westmoreland had proved the iodide process to be a good one; but he doubted whether the trade would all at once abandon the Cornish assay and substitute the iodide process for it.

Mr. TATE agreed with the last speaker that many of the errors which occurred in reports upon copper were due more to sampling than testing. Sampling was certainly not in so perfect a state as it should be. He had seen tests for moisture made by samplers by simply drying the ore in a vessel like a frying pan or saucepan lid in such a manner that no one could tell whether all the moisture had been driven off or whether the sample had lost something besides water. This practice was still in vogue, for he had himself received samples for analysis, supposed to be dry, which yet contained much moisture, showing that, though some attempt had been made to get at the moisture, yet the estimation had been conducted without reasonable care. Every assayer should take careful note of the moisture present and the method of testing for it. It was therefore necessary, before passing judgment on the different methods of assaying, to ascertain whether their methods of sampling could be improved. Sampling was as much a science as assaying, and well worthy of attention. Whatever might be said in favour of the relative merits of wet and dry assays, much depended on the experience of those who made them; and concordant results could not be expected without constant practice. He was not certain that the old Cornish assay would give concordant results in the hands of different operators and in different laboratories, but what he objected to particularly was its secrecy, and the close way in which it was confined to a few operators. This was a totally wrong principle. On the other hand, he agreed in the main with Dr. Hurter that the Cornish assay had been found by commercial men to give them a reliable indication of the value of ores; and he did not wish to supersede a method said to be a sufficient guide without grave reason. The author had overlooked one aspect of the commercial question when he alleged that the difference between the dry and the wet assay was a measure of the difference between the money values of coppers. This was really not the case, because the buyer had to take into consideration the loss of copper in the smelting operation. It was not exactly a relative difference in value between two assays which would guide him.

Mr. WESTMORELAND said this was a misunderstanding; it was only a difference between wet and dry assays.

Mr. TATE was sorry if he had wrongly interpreted the author, but there was a money value given, and the paper gave him the impression that the figures between the two kinds of assay indicated a certain money value. The real question at issue was whether the dry assay gave figures in fair correspondence with the results obtained on the large scale. His own impression was that, by recent improvements in smelting and refining copper, there was a far larger yield than the dry assay would seem to indicate, and for his part he would be glad to see the dry assay abolished. As regarded the various wet methods, there was first the cyanide process. It had undoubtedly been found useful in works, and in the hands of competent persons gave very concordant results; but he questioned whether it would give equally good results in the hands of different operators working in different laboratories, unless they formulated a definite method of procedure never to be deviated

from. He had not found the electro-deposition process altogether satisfactory; and when they had figures varying from twenty-seven to twenty-one put before them by a careful operator, it indicated what differences could result from its use in various laboratories. Of all the processes mentioned, the iodine method seemed to be the best as being least liable to error, and if any change were to be made and the dry assay given up, then this seemed eminently the one to succeed it. On the whole he agreed with the author's conclusions, but must dissent from the grounds on which he based his arguments in favour of a change from the dry to the wet assay.

The CHAIRMAN was sorry to say it was a long time since he personally tested copper ores, but he had pretty considerable experience in testing it in former times, and also of sampling, and he might say his experience entirely coincided with that of Dr. Hurter, that the great losses they always sustained arose from sampling rather than testing. Twenty years ago he was very much surprised to find that in a cargo of pyrites, of 250 or 300 tons, his firm lost £300. They did not certainly get the copper in the burnt ore, but they paid for it in the raw ore, and when he came to look into the matter he found the loss arose from sampling. Since then the sampling had been conducted in a much more satisfactory manner, and he did not think there were the same objections now that there were in former times. As regarded the testing and analysis of ores, he was rather inclined to agree with Mr. Westmoreland, who had laid down a number of propositions in his paper. First that the moisture in the copper ore should be more clearly defined, and notwithstanding the discussion that evening he quite thought this was the case. He quite saw that with ores so different as sulphur ores and precipitate, they must possibly work at different temperatures, but still it was desirable if they could arrive at some common understanding on the subject. It was desirable that if they determine the moisture, they should determine it at some definite temperature. He thought this was perfectly clear, and he had not the slightest doubt that if the chemists and the manufacturers and the assayers, would put their heads together, they would be able to discover some more satisfactory manner of determining the moisture than was adopted at present.

With regard to Mr. Phillips' suggestion, as to sending the dry sample to the assayer, and assaying the sample in the dried state, he thought it would not be impossible to have the sample pulverised sufficiently fine that it could be used in that state for the assay and determining the test. If that could be done it would overcome that difficulty. Then Mr. Westmoreland said that in wet assays of copper ores he preferred the iodide process, and from the general discussion the iodide process seemed to be accepted as a fairly accurate and rapid one, and that concordant results were obtained. He was surprised to hear that the electro-deposition process was interfered with by the presence of bismuth and silver, when Mr. Claudet, who had enormous experience, wrote to Mr. Phillips and said that of all the processes the electro process was to his mind the most perfect, and as the deposition could take place during the night the assay was practically as rapid as any other. Of course the cyanide process was at first adopted on account of the rapidity with which it could be carried out, and it was still used, when they did not want a very accurate process, because they could carry it out in a rough way very rapidly. But when it was necessary to take great precautions (he remembered the time when it was not considered necessary), they then got most discordant results. Now, apparently, the iodide process could be carried out as rapidly as

the cyanide process, and if they got two processes which could be carried out with equal rapidity, it was better to take the one which was more accurate. As regarded the Cornish process and the dry assay, there was a great difference between the Cornish process as adopted to-day and 20, 30 or 40 years ago. Formerly it seemed to him that it simply meant a buyer's assay and a seller's assay; one got one result and the other another, and then it seemed really a toss up in agreeing to the produce between them, because really the difference was enormous. He hardly ever found two Cornish assayers to agree. The process was perfectly ridiculous from a scientific point of view; but soon after the alkali manufacturers began to receive copper ores and to test them, having competent chemists in their works, and finding these enormous differences, they looked to their Cornish assayers to assay by the wet method, saying at the same time, "We make this ore so much," and it was absolutely impossible that the dry assay could make it above a certain figure. The Cornish assayer now, he believed, used the wet method in order to control the dry assayer. This fight had been going on for the last 20 or 30 years, and as Mr. Phillips said, they were now fairly satisfied with the Cornish assay. Well, he supposed he ought to say that he was fairly satisfied, but would they tell him that it was a method with which chemists ought to be satisfied? He thought there was no chemist who would say that he was satisfied with the Cornish assay. At the same time it worked in a way which was well understood in the trade, and it was very difficult to understand a thing of that kind, still it was not impossible. He had supported Dr. Lunge's international methods of sampling and testing, and he thought, on the whole, Mr. Westmoreland's paper was in favour of that proposal rather than against it. He thought that in some future time they should have some agreement as to the wet assay of copper ores, and that copper ores would be sold by the wet process, as more accurate. Although it was difficult, it was not impossible to come to an agreement about a test. Dr. Hurter remembered the difficulty they had at one time about the determination of the value of the manganese ores, when the Spanish manganese ores first came into the market. They found the oxalic method gave results too high, and at any rate the results were unsatisfactory, as they really paid too high a value for the ore, taking the quantity of chlorine yielded when treated with HCl; and they determined, after discussing the matter, to have a different method of analysis, and they adopted one, after consultation with analytical chemists, which had since given satisfaction.

Mr. WESTMORELAND said, in reply, that with regard to the moisture determinations, he had suggested that dried samples should be forwarded to the assayers, who could re-dry them at a low temperature to expel any hygroscopic moisture which had been absorbed after the determination was made. Although it was true that the moisture in different ores was expelled at varying temperatures, yet the adoption of a definite fixed temperature would prevent the discrepancies which now occurred; for what was required was that the samples should be in the same state of partial or complete dryness when assayed as when the moisture determination was made. The determination could not be safely abandoned, as some speakers had suggested, for some years ago he made experiments, taking the moisture on rough samples of ore, and also on other portions of the sample which had been finely powdered, for analysis, when a serious loss of moisture was found to occur during pulverisation. The discrepancies which have been noted by Mr. Tate between his estimations of moisture

and those stated on bottles containing samples, have been generally observed, and may result from the sample having been exposed or reduced to a finer state of division after the determination was made. Whatever may have been the case formerly, he believed that samples were now, as a rule, taken very carefully, and that the discrepancies in assays which he had pointed out were not due to errors of sampling, but to other causes. Take, for instance, the assays on page 57, where two assays of the same sample gave 33 and 35½ per cent. respectively; it was evident in this case that the method of assay and not the sampling was at fault. He was well acquainted with the details of the process of assay mentioned by Mr. Rawson; but the fact that the necessary precautions were observed in the laboratories from which results of wet assays had been quoted, shows that very discordant results were obtained by operators constantly using the process, and whatever modifications were introduced in different laboratories, concordant results should be obtained if the standardising of the cyanide solution was conducted in the same manner as the tests were made. Some speakers laid stress on the fact that concordant results were obtained by them when using the cyanide process; but concordant results alone were very unreliable indications of the value of a method of analysis. What was required was that the results should express as accurately as possible the absolute amount of valuable matter (in this case copper) in the material under trial, and the method which indicated this most accurately should be used for commercial purposes. The cyanide process as described by Mr. Rawson was quite as troublesome as the iodide method, with the disadvantages that a standard solution very liable to change was employed, and that the end reaction was by no means of a very definite character. On referring to his paper, differences of more than 25 per cent. would be found, and Mr. Rawson acknowledged that errors of 15 per cent. might occur in duplicate assays of the same sample. In his own practice, testing green and burnt ores by the iodide method, using very different weights of ore, say 50–100–150 grams, he should not allow greater differences than 0.4 per cent. to pass without retrial. He was aware that the process by the ignition of cuprous sulphide in a current of hydrogen gas was used for the estimation of copper in green ores and precipitates, but it involved the assumption that no other metals except copper were present, giving sulphides not volatile at a red heat; but samples were often examined containing silver, tin, bismuth, etc., and he had also examined samples of precipitate containing 4 per cent. of lead; in these cases the process would be liable to serious error. Regarding the electro-deposition method, he had not noticed the extreme variations mentioned by Mr. Rawson, and the fact that the iodide method was used to check the results of pyrites assays by electro-deposition, confirmed his statement that the iodide was the more accurate process. Dr. Hurter remarked that the only way in which his employers lost money was by errors of sampling, and not by discrepancies in the dry assays. The difficulty was that when discrepancies occurred it was impossible to obtain authentic portions of the samples operated on, in order to see where the error really occurred. Take, for example, the following assays of pyrites: Works' wet assay, 2.05 per cent.; buyer's and vendor's dry assays, 1¼ and 1⅓ per cent. respectively; referee's return as umpire, 1½ per cent.; margin between settled produce and wet assay, 30 per cent. The referee strongly asserted that his assay was correct, and the unfortunate sampler received all the blame. He could not agree with Dr. Hurter that the dry

assay was in the copper trade the equivalent of the English degree in the alkali trade. The cases were not parallel; for the English degree was obtained by a *well-defined and chemically exact process*, the equivalents only being in error, while the dry copper assay was liable to serious variation even in the hands of experienced operators. The method proposed for copper tests—viz., using an accurate and exact process of wet assay, deducting a margin, and taking the product as an equivalent to the present dry assay for commercial purposes—would be an exact parallel to the English alkali degree. He thought Mr. Tate had misunderstood his remarks regarding money value in cases of discrepancies. In the assays of parcels of similar material—for example, cupreous pyrites—the settled produces should vary to the same extent as the wet assays. Thus, if there was 25 per cent. difference between the wet assays of two parcels, the settled produces dry assays should vary to the same extent. Therefore if the wet assays of one parcel varied by this percentage, which was on one basis of valuation worth 3s. per ton of ore, they might, he thought, say that the difference in value by discordant assays would be equal on a parcel of 240 tons ore to £36. The same rule was followed elsewhere, wet assays being compared with wet assays, and dry assays with dry assays, the differences being calculated into money value on the parcel. Mr. A. G. Phillips had stated that he (Mr. Westmoreland) seemed to think that vendors and purchasers of copper ores were not aware that the dry assays did not give the absolute amount of copper in the sample. He was not aware that he had stated this with regard to copper ores, but Mr. Phillips might perhaps be interested in knowing that several large dealers and brokers of bar-copper were not aware of the fact until it was explained by him. Mr. Phillips was also in error regarding his position in Cornwall. He was not assistant to—but chemist with—a dry copper assayer, and in that capacity he made whatever changes he pleased, and used any methods of analysis, assay, etc., he thought proper, without reference to his employer or any other person. Regarding the method of dry assay, not one of the facts or statements he had made regarding the process had been challenged. Was it true, as several speakers had asserted, that the dry assays were accepted as satisfactory either by vendors or purchasers? Was it not a fact that constant complaints were being made regarding the margin between the "settled produces" and wet assays.

If the dry assay furnished any indication of the yield or quality of the metal produced on the large scale, there would be some reason for its retention, but this was not the case. His proposal to use the iodide method, deducting a margin, as a basis, would enable all the present trade customs to be retained, and would be more satisfactory to both buyers and vendors than the present system.

He considered that his statements regarding the inaccurate and unreliable results of the dry assay had not been disproved, and that he had shown that the iodide method was the most reliable process for the estimation of copper.

Manchester Section.

Chairman: Sir H. E. Roscoe, M.P.

Vice-Chairman: I. Levinstein.

Committee:

R. F. Carpenter.
C. Estcourt.
H. Grimshaw.
B. W. Gerland.
Peter Hart.
T. Jackson.

D. B. Hewitt.
C. Schorlemmer.
Watson Smith.
L. Siebold.
Wm. Thomson.
D. Watson.

Local Secretary

J. Carter-Bell, Bankfield, The Cliff, Higher Broughton, Manchester.

MEETINGS, SESSION 1885-86.—First Tuesday in each Month, at 7 P.M.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

SUPPLEMENTARY NOTES ON THE METHODS OF EXAMINING FIXED OILS.

BY ALFRED H. ALLEN.

THE following notes connected with points referred to in the paper I read before this Section at the January meeting:—

Valenta's Acetic Acid Test.—In the table published on page 69 of the *Journal*, owing to the undue extension of a bracket, sperm oil and whale oil are represented as being insoluble in an equal measure of glacial acetic acid, even at the boiling point. This is not the case, and, in order to prevent misconception, I give below the temperatures at which their solutions in glacial acetic acid were observed to become turbid, together with similar results obtained with other oils since my last paper was read. The observations were made at my request by Mr. W. Wright. As before, I have placed in juxtaposition the figures obtained by Valenta with specimens of the same kind of oils.

KIND OF OIL.	Turbidity-temperature, °C.	
	Valenta.	Allen.
Whale Oil, No. 1	—	38
„ No. 2	—	86
Bottlenose Oil	—	102
Sperm Oil	—	98-103
Seal Oil	—	72
—	—	—
Linseed Oil, No. 1	—	57
„ No. 2	—	74
„ No. 3	—	73
Cotton-seed Oil	110	90
Rape Oil	insoluble	insoluble
Blown Rape Oil	—	52
—	—	—
Cocoa-nut Oil	40	75
Palm-nut Oil	48	32
Laurel Oil	26-27	40
Nutmeg Butter	27	39
Cacao Butter	105	insoluble

Of the two samples of whale oil examined, No. 1 contained a proportion of glycerides of volatile fatty acids corresponding to 5.1 per cent. of valeric acid, while No. 2 contained only the equivalent of 1.5 per cent. of that acid. The results furnish another instance of oils containing lower glycerides being comparatively easily soluble in glacial acetic acid. The variations between Valenta's figures and those obtained in the author's laboratory show that too

much reliance must not be placed on the indications of the test, which, however, is capable of very useful application in certain cases. Thus, further most encouraging results have been recently obtained with butter and lutterine, but I reserve a full description of these experiments for a future paper.

Bromine Absorptions of Oils.—In my last paper I gave a table in which the proportion of bromine, found by Dr. E. J. Mills and his coadjutors to be absorbed by various oils, were compared with the corresponding iodine absorptions as determined by Hübl. It is only just to Dr. Mills to state that the value I gave for the bromine absorption of almond oil was that found by Mills for the oil expressed from bitter almonds, whereas the result he obtained for the oil from sweet almonds does not present so strongly the anomaly to which I called attention. Since the publication of my last paper, Mr. T. Maben (*Pharm. J.* [3], xvi. 797) has determined the bromine-absorptions of apricot and peach oils, with the results incorporated in Table A on page 283, together with the iodine-absorption found by R. W. Moore for almond oil.

The difference in the bromine-absorption found by Mills for the oils from sweet and bitter almonds is striking, especially as the *British Pharmacopœia* regards the oils as so similar that the use of the one or other kind of nut is optional. As a matter of fact, however, nearly all the oil of commerce is expressed from bitter almonds, as the mark of these is then available for preparing the essential oil. But a bromine-absorption of only 26, if it really corresponds to the triolein present, points to the presence of fully 50 per cent. of palmitin or other solid fats, a proportion which would give an oil the consistency of lard or tallow. On the other hand, the iodine-absorptions of Hübl and Moore are inexplicably high for a non-drying oil, for (multiplied by the factor 1.152) they represent more than 100 per cent. of triolein.

Determination of Glycerin.—In my last paper I mentioned that I had not succeeded in obtaining methyl alcohol which could, by any reasonably simple method of purification, be rendered suitable for effecting the saponification of fixed oils prior to the determination of the resultant glycerin by the permanganate process. In accordance with a recommendation made during the discussion on my paper, I have since applied to Mr. C. A. Fawsitt, who has kindly supplied me with some methyl alcohol which, after rectification with a little caustic soda, is all that can be desired. By the aid of this purified product, I have made determinations of the glycerol in other samples of saponified oil, and have found that, in the case of oils which have been gravely modified in their characters by oxidation, bodies are developed that yield oxalic acid on treatment with permanganate and alkali, and hence vitiate the determination of glycerine by this process. Thus a sample of genuine steam-boiled linseed oil showed 9.94 per cent. of glycerin by the permanganate process against 8.78 per cent. actually isolated. These results show as near an agreement as might be expected, when the unavoidable loss of glycerin by volatilisation in the latter process is taken into account. On the other hand, when the same oil was allowed to dry completely by exposing it in thin layers on glass plates, at a temperature of 100° C., the product when oxidised with permanganate gave oxalic acid equivalent to the impossible proportion of 15.52 per cent. of glycerol, while the amount of the same substance actually isolated in a moderately pure condition was only 6.4 per cent. The discrepancy is probably due to the formation of soluble oxidation-products capable of yielding oxalic acid on further oxidation. Acids of the acrylic series are

known to have this property, and are said to be produced by the oxidation of linseed oil.

In addition to those already mentioned, I have to acknowledge the zealous assistance of Messrs. W. Chattaway, H. G. Hardy, and W. Barraclough, in carrying out the numerous experiments, the results of which are recorded in this and the foregoing paper.

A FEW FACTS IN THE HISTORY OF SOLID CAUSTIC SODA.

BY P. HART.

IN Dr. G. Lunge's excellent book, "Sulphuric Acid and Alkali," vol. i. p. 592, he says: "It is just possible that solid caustic soda was made somewhere between 1845 and 1851, but the fact that not a single English patent about it was taken out during that time tells against that assumption." The statement may be historically interesting that to my personal knowledge solid caustic soda was made, under the direction of the late Dr. Young, of paraffin oil celebrity, at the Manchester Ardwick Bridge Chemical Works, previous to 1852. Dr., then Mr. Young, left the service of Messrs. Tennants & Co. about August in that year, and during the previous twelve or eighteen months

and his employers failed to see, very legitimately turned his attention to the matter, and, combining the information so obtained with Brown's previous patent (Lunge, vol. ii. p. 592), succeeded in working out his method of producing solid caustic soda from what may be termed soda ash mother-liquor. At all events, the fact of his obtaining a patent for this so immediately afterwards as May, 1853, I think adds great weight to my inference.

ON THE ESTIMATION OF SULPHUR AND IMPURITIES IN COAL GAS.

BY T. FAIRLEY, F.R.S.E.

THE manufacture of coal gas is controlled, as regards purity and quality, by the different Acts of Parliament relating to the districts where the gas is supplied.

In London it is required that the gas shall be free from sulphuretted hydrogen, and that the proportion of sulphur in other sulphur compounds shall not exceed 20 grains in winter nor 17 in summer in 100 cubic feet of gas. It is also required that the ammonia shall not exceed 4 grains, but no limits are specified as regards air or carbonic acid.

TABLE A. (See Mr. Allen's Paper on p. 282).

	BROMINE-ABSORPTION.		IODINE-ABSORPTION.		
	Mills.	Maben.	$\frac{1}{100}$ Br.-absorp.	Hubl.	Moore.
Almond Oil (Bitter)	26.3	—	11.8	97.5 to 98.9	98.91 "
Almond Oil (Sweet)	53.7	—	85.3		
Apricot-kernel Oil	—	70.0	111.1	99 to 102	—
Peach-kernel Oil	25.4	—	40.1	—	—
Peach-kernel Oil	—	77.0	122.2	—	—

was busy completing his company's works at Bathgate and producing oils there. As is well known, at one stage of the manufacture of paraffin oils, they are or were treated with sulphuric acid, with an after treatment of caustic soda. Now, whether Mr. Young found this latter article difficult to obtain in his new neighbourhood, or from secretive reasons, or disliking the trouble of erecting plant for the causticising soda ash, I do not know, but the fact remains that during the period named some tons of solid caustic soda were made by boiling down the ordinary commercial liquid caustic soda of 70° Tw. As Mr. Young was the only customer, comparatively small quantities were made, and its manufacture did not last long. A cast-iron pot, 6 feet diameter and 3 feet deep, was employed. As the water evaporated, the solution caustic was dribbled in until a sample taken out would set. At this stage the fire was withdrawn, and the pot baled out on to long iron trays. As it set it was broken up with chisel-ended bars into small pieces, and finally packed into American potash barrels. But another fact lies behind this. During a portion of the period when this was going on, the late Mr. William Gossage was experimenting at Ardwick Bridge with his patent method for concentrating sulphuric acid (Lunge, vol. i. p. 556—7), and as no secret was made of this solid caustic soda, it being only made for Mr. Young's convenience, and probably seemed to have no commercial worth, I think it likely, indeed, that Mr. Gossage, having ample opportunity, saw this process being carried on, and seeing in it a commercial future which Mr. Young

In Leeds the gas committee have for some years sought to obtain something like the same standard of purity as is required in London, especially as regards sulphur compounds, and I have made numerous tests weekly at the three different gas works, and at my own laboratory.

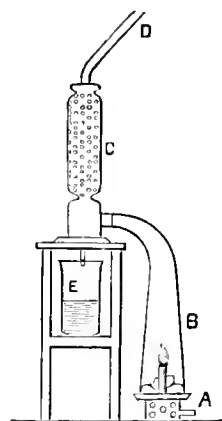


FIG. 1.

These tests have generally been made by the apparatus introduced by the London Gas Referees, shown in Fig. 1. A is a small Bunsen burner with steatite top placed in a perforated cylindrical stand, having a cylindrical channel to receive the glass trumpet B,

between which and the top of the burner are placed about 2 ounces of ammonium sesquicarbonate. The products of combustion pass by the trumpet into the cylinder C, packed with glass balls, and provided above with a long tube D for purposes of draught, etc. At the bottom of the cylinder is a narrow tube to allow the condensed liquid to pass into the beaker E. The gas is thus burnt in an atmosphere more or less charged with ammonia, the flame shows at its edge the pale orange tint shown by the burning ammonia. The same purpose may be effected as shown by Mr. W. C. Young (*Analyst*, 1876, p. 143), by placing crystals of sodium carbonate in the upper part of the cylinder.

In this apparatus the Referees require that the gas should be burnt at a rate not exceeding half a cubic foot per hour, in a room where no other gas is being burnt at the time; and that the tubulures or narrow parts of the trumpet and condenser should have a diameter not less than three-quarter-inch, so as to permit a sufficient excess of air to pass through the apparatus. (This latter condition is very frequently neglected by the makers and dealers in these apparatus.) In measuring the gas, corrections should be made for variations in temperature and pressure. The condensed liquid and washings of the whole apparatus are finally made up to a given volume of which a fraction can be taken for estimation of the sulphur as barium sulphate in the usual manner.

In the estimations of sulphur in coal gas by this method, the following suggestions which I have to make may be useful:—

(a.) If the gas burnt amounts to 2·12 cubic feet, or if the portion of the condensed liquid taken corresponds to 2·12 cubic feet, then the barium sulphate weighed in centigrams gives at once the grains of sulphur per 100 cubic feet of gas *without calculation*. If a multiple of 2·12 cubic feet be taken, then the calculation is of the simplest character.

(b.) In acidifying the liquid with hydrochloric acid before adding the barium chloride, it is well to use hydrochloric acid, charged with free bromine, to secure complete oxidation of any products in the condensed liquid. If the supply of gas be not very perfectly governed, the flame may enlarge, and the products for the time being may be imperfectly oxidised. The tests should not only be made in a room where no other gas is burning, but as free as

experiment made with a similar apparatus, using a small spirit lamp, with its flame surrounded with ammonium carbonate, instead of the gas burner, and adjusted to about the same size of flame, will, when kept burning during the same time, afford the means of making an approximate correction for impurity contained in the air.

The Referees' apparatus and mode of testing was a distinct advance on any other previously in use, such as Letheby's (Fig. 2) or Wright's (Fig. 3), or even Letheby's apparatus with additional cylinders, as proposed by Anderson.

Even with experienced workers, however, the Referees' apparatus sometimes gives wide fluctuations in consecutive tests, and there is a suspicion that these fluctuations do not really exist in the composition of the gas.

In very cold weather the sulphur sometimes drops down considerably, probably from the partial condensation of carbon disulphide or other organic sulphides in the mains or pipes.

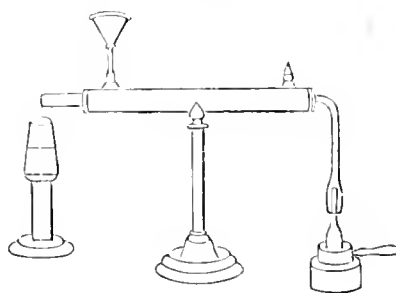


FIG. 3.

The American chemists, Messrs. Sadler and Silliman, in 1877 (*Journal of Gas Lighting*, vol. 24, p. 461), proposed a modified form of the Referees' apparatus. They abandon the use of ammonium carbonate, and allow to run in at the top of the condenser standard alkali from a burette. By reading off the volume of standard alkali run in during the combustion of a certain volume of gas, the loss of alkalinity corresponds to the sulphur oxidised from the gas. When this titration method is adopted it is essential that the gas be thoroughly purified from ammonia before passing through the meter. The ammonia apparatus may be fed with standard acid and used as a means of estimating the ammonia in the gas.

The following are the results of tests made by me simultaneously by the Referees' method, and by that of Sadler and Silliman, the sulphur being stated in grains per 100 cubic feet of gas:—

Referees.	S. and S.
16·26	16·59
21·43	21·88
15·06	15·79

The latter method has the advantage that, by changing the receiver without washing out the apparatus, it may be used as a continuous process.

In the *Journal of Gas Lighting* for March 16, 1884, Mr. J. A. Wanklyn described a method in which he used the Referees' apparatus without ammonium carbonate, but placing iodine in the upper part of the condenser above the glass balls. Mr. W. J. Dublin described an extensive series of experiments carried on by the late W. T. Keates in 1877, on the same process. Generally the iodine process gave rather higher results than the ammo-

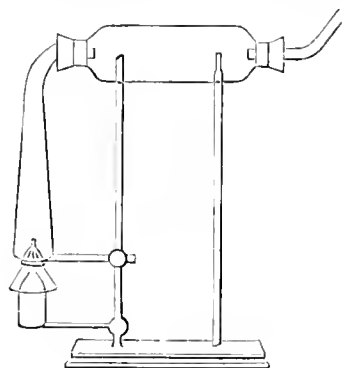


FIG. 2.

possible from draughts and currents. No carbon disulphide or other volatile sulphur compounds should be permitted in the room. Where oxidation has been complete, the condensed liquid will be colourless, or nearly so. I have calculated that at least twenty volumes of air pass through the apparatus for one of gas. In places where tests must be made in a somewhat impure atmosphere, a blank

mium carbonate process. The following are from simultaneous tests made by me :—

Ammonium Carbonate.	Iodine.	Hydrogen Dioxide.
16.79	17.59	17.66 by titration.
		17.42 by precipitation.

The following is a new process which I began to use some years ago, and which I submit has certain advantages. As there are no solid products, it may readily be used without washing out as a continuous process. It consists in using a very dilute solution of hydrogen dioxide run in at the top of the Referees' apparatus, and the plain flame under the trumpet without ammonium carbonate. The oxidising effect is very complete, even in solutions containing less than one per cent. of real dioxide. The equation is $H_2O_2 + SO_2 = H_2SO_4$, and hence the liquid may either be titrated with standard alkali, or acidified and precipitated with barium solution in the usual manner. The hydrogen dioxide of commerce containing from three to six per cent. of real dioxide, is diluted to about one per cent., and if slightly acid its acidity may be determined, or it may be exactly neutralised before use with decinormal solution of ammonia. Ammonia has much less effect in tending to decompose the dioxide than any other alkali. If the sulphur oxidised from the gas is to be estimated by precipitation, the dioxide should be free from barium in solution, which would precipitate in the condenser as barium sulphate. The gas to be tested should first be freed from ammonia.

The hydrogen dioxide is run in very slowly at the top of the apparatus, by a device adopted by Sadler and Silliman, in running in the standard alkali in their method. About seven inches of fine thermometer tubing is double bent into an inverted Π form, and connected with a burette or bottle containing the liquid. Such fine capillary tubing chokes readily with the slightest sediment deposited from the liquid, but by allowing the liquid to pass upwards into the fine tube, one leg of which is placed in the wide tube above the condenser (Fig. 1), and hangs from it, there is no tendency to choking. By slightly raising the bottle or burette containing the liquid, it is easy to regulate the flow to, say one drop in three minutes, or from two to three cubic centimetres per hour.

This method may be used either intermittently or continuously. In the former case the sulphuric acid in the condensed liquid and washings may be determined either by titration or precipitation, or both, and in the latter, the receiver being changed, the volume of gas required is burnt, and then the sulphuric acid estimated in the liquid collected without disturbing the rest of the apparatus. With a sufficiently large supply of the dilute dioxide in the feeding bottle, a test may be carried on for days continuously, or even a week, and a fractional part of the whole liquid taken, thus enabling one to get a real average from all the gas passing through the pipes during the long experiment. The following are the results of experiments carried on simultaneously, generally on ten cubic feet of gas the sulphur being stated as before in grains per 100 cubic feet :—

Ammonium Carbonate.	Hydrogen Dioxide (precipitation).	Hydrogen Dioxide (titration).
19.21	19.32	19.61
19.42	19.55	19.30
17.98	—	18.20
18.48	18.90	—
16.12	17.03	—
16.41	17.72	—
16.79	17.23	17.66

The estimations of carbonic acid and of ammonia in coal gas are made by processes substantially the same as those described in many text-books.

Where the carbonic acid is over one per cent., approximately accurate results may be obtained by the use of Bunté's gas burette, of which I have two simplified and modified forms on the table. Fig. 4 is the ordinary Bunté gas burette. Fig. 5 is a gas burette without the three-way tap, made from an ordinary burette by joining to it at the top a glass tap and cup. Fig. 6 is an ordinary burette made into a gas burette by means of a perforated caoutchouc stopper very tightly fitted in the top of the burette just above the graduation. The working of these burettes is similar to that of the Bunté, except that the one shown in Fig. 5 has to be filled with the gas when in an inverted position. When the gas has been purified by lime, the carbonic acid may fall under one per cent., and then a standard solution of barium hydrate must be used, contained in an ordinary absorption or wash-bottle apparatus, arranged to give as small bubbles of gas as possible. After passing a measured volume of the gas through a measured quantity of the barium hydrate solution, and allowing the precipitated carbonate to settle, a

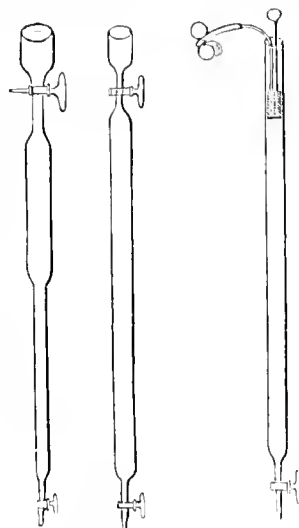


FIG. 4. FIG. 5. FIG. 6.

portion of the clear liquid may be titrated, and the loss of alkalinity corresponds to the carbonic acid present in the gas.

When the carbonic acid has been determined in a gas burette by the use of sodium hydrate, a further addition of pyrogallol solution shows by the colour produced if air is present, and if there is any appreciable quantity the oxygen corresponding to the air is absorbed.

Mr. Wanklyn has proposed a method for the estimation of carbonic acid in coal gas (this Journal, 1884, page 12). A clean dry glass bottle, holding about one-tenth of a cubic foot, has fitted to it a stout test tube as a stopper. The bottle is filled with the gas by displacement, and the test tube contains a known quantity of standard barium hydrate solution. On shaking the liquid into intimate contact with the gas in the bottle and then allowing the liquid to settle till clear, the titration of a portion of the clear liquid gives the loss of alkalinity of the solution corresponding to the carbonic acid in the gas taken.

The ammonia in coal gas is estimated by passing it through a wide tube filled with glass beads or

broken glass, which have been previously moistened with a measured quantity of standard acid. The beads or glass used must be tested for alkalinity very carefully, as some kinds are quite unfit for the process. Messrs. Sadler and Silliman suggested passing the gas through an upright tower somewhat similar to the condenser in the Referees' sulphur apparatus, but used in an inverted position and filled with broken glass (*Journal of Gas Lighting*, vol. 24, 461). Standard acid was allowed to run in very slowly at the top from a burette, and ran out by a U-shaped fine tube at the bottom. The loss of alkalinity of the acid gave the proportion of ammonia present. This process they used as a continuous one without washing. I have made some experiments by this process, and generally find that I obtain more ammonia by it when used as a continuous process than by the Referees' ammonia apparatus. On starting the two apparatus the results at first are practically the same.

The following are the results in grains per 100 cubic feet of gas, operating in each experiment on about ten cubic feet of gas:—

	Referees.	S. and S.
I.	0.47	0.49
II.	0.49	1.56
III.	0.44	1.57

I have set up a similar apparatus to the above for the estimation of carbonic acid by a continuous process, using a standard solution of pure sodium hydrate to pass through the scrubber. The liquid in the burette and in the receiving vessel below must be completely protected from the atmospheric carbonic acid. After passing through the apparatus, a measured portion of the sodium hydrate solution, corresponding to a given volume of gas, is mixed with a measured quantity of standard barium hydrate sufficient to more than precipitate all the carbonic acid present. On allowing the barium carbonate to settle, a fractional part of the liquid gives, by titration, the loss of alkalinity corresponding to the carbonic acid absorbed.

I have to thank my assistant, Mr. Walter Leach, for his valuable aid in making many of the estimations required in this investigation.

NOTE ON THE DETECTION OF CERTAIN ADULTERATIONS IN DYESTUFFS.

BY T. FAIRLEY.

SOME time ago I received a sample of archil paste (a preparation of cudbear), which was suspected of being sophisticated with an aniline colour, such as magenta.

I endeavoured to make a separation of the colouring matters, making use of the insolubility of the aniline colour in strong aqueous ammonia. By taking a small quantity of the paste and treating it with successive portions of ammonia, all the natural colour of the dyestuff may be removed. On afterwards adding alcohol, the aniline colour appears in its own proper colour.

Sometimes dyewoods, such as logwood, have been faced with magenta, though I have not met with this lately. The above method would be applicable also in that case.

NOTE ON THE SOLUBILITY OF SILVER CHROMATE IN AMMONIUM NITRATE.

BY R. FORBES CARPENTER.

IN the 12th and 13th Reports of the Chief Inspector under the Alkali Acts, pp. 60, 61, mention is made, under the heading of "Estimation of Hydrochloric Acid," of precautions to be observed as to temperature of solution in using potassium chromate as an indicator, which were communicated by Mr. T. F. Stuart, of Hepburn. It is not there suggested that the solubility of silver chromate in the alkaline nitrate produced in the reaction is one of the causes of the excess of silver solution required to obtain the reaction in hot solutions; but that this will suggest itself as possible has been noticed this year in a paper (extracted in the *Chemical News*, vol. liii. No. 136), by G. Biscaro, "On a Defect in the Volumetric Estimation of Chlorine by Mohr's Process" (*Ann. de Chim. Med. Farm. und Chemische Industrie*). Biscaro notes that "if nitrates, especially those of the alkalis and alkaline earths, are simultaneously present, the precipitation of the red silver chromate often takes place too late, whether because such nitrates form double salts with silver nitrate, which are not precipitated by potassium chromate, so that decided excess of silver becomes necessary, or that the silver chromate already formed is slightly soluble in those waters."

My own experience goes to show that the latter is the true answer. In 1884, in the course of a chimney test for HCl, I accidentally discovered, by the use of a wash-bottle containing ammonia (in washing to add to the filtrate from soot, etc.), that on neutralising with nitric acid and proceeding with Mohr's test in a hot solution, the quantity of silver solution used was enormously in excess of that required by the chlorine present. Both the accidentally introduced ammonia and nitric acid were free from chlorine, and after apparently exhausting all other possibilities, it became clear that the alkaline nitrate in hot solution dissolved the silver chromate as quickly as it was formed. Experiments were carried further, and freshly-precipitated silver chromate was treated with strong ammonium nitrate solution. In the cold, solution of the already formed and not nascent chromate is feeble, though decided, as the solution instantly assumes a bright yellow colour. On warming, the rate of solution rapidly increases up to the boiling-point; on cooling, the silver chromate crystallises out in beautiful needle-shaped crystals.

In reference to Mr. Stuart's experiments, mentioned at the commencement of this note, I would observe that although the test-books recognise that silver chromate is "sparingly soluble" (Miller), and that Mr. Stuart's experiments go to prove that the solubility is greater in hot than cold water—yet that, reasoning from the behaviour of ammonium nitrate in hot solutions, the potassium nitrate formed in the double reaction may exert an influence of equal moment.

	50° F.	210° F.	Grains Silver Chromate dissolved in hot solution.
a—Pure Water.....	0.05cc.	0.25cc.	0.054
b—Sodium nitrate....	0.05	0.25	0.064
c—Potassium „	0.10	0.75	0.192
d—Ammonium „	0.07	1.25	0.320
e—Magnesium „	0.35	1.0	0.256

Some experiments have been made to determine the relative solubility of silver chromate in the nitrates of potassium, sodium, ammonium, and magnesium in cold and hot strong solutions. Fifty grains of each of the above named salts were dissolved in 100cc. of water, and the amount of deci-normal silver nitrate solution taken to obtain the reaction with potassium chromate noted. (See table.)

In the three later cases I have deducted the amount of silver chromate dissolved by the water alone, and have given the amount due to the solvent action of the respective nitrates. From all these the silver chromate crystallises out again on cooling.

NOTE ON SOME CONDITIONS AFFECTING THE OXIDATION OF NITROUS ACID TO NITRIC ACID.

BY R. FORBES CARPENTER.

In the "Alkali Maker's Pocket-book" of Drs. Lunge and Hurter, p. 151, it is stated, as to the use of methyl-orange (Poirrier's orange No. 3) as an indicator in acidimetry, that "in some cases methyl-orange fails to yield good results from causes not yet ascertained—*e.g.*, in chimney testing." On inquiry from Dr. Hurter, I learned that the failure of the indicator had not come within his own personal experience, but had been reported to him by Mr. E. G. Ballard, H.M. Inspector residing at St. Helens.

Now, as the best and most complete comparison of indicators has been made by Mr. Robert T. Thomson, in the papers read by him before the Chemical Section of the Glasgow Philosophical Society, commencing January 22, 1883 (reprinted in the *Chemical News*, vol. 47, pp. 123, 135, etc.), I feel confident, in referring to this exhaustive paper, that I am quoting an authority on the subject treated of. From this I gather that the only mineral acid in the estimation of which methyl-orange distinctly fails is nitrous acid, which, indeed, alters the constitution of the indicator entirely.

My own experience in 1882 had led me also to the conclusion that in the presence of alkaline nitrites methyl-orange is valueless as an indicator; and this brings me to the subject of my note.

On entering upon the duties of inspection under the Alkali, etc., Works Regulation Act of 1881, I devoted some attention to the subject of what were the best and most rapid absorbents for the acid gases of sulphur and nitrogen escaping at the vitriol-chamber exits, and selected for the absorption of the acid gases contained in one cubic foot of acid gases a mixture of 10cc. normal caustic soda, with 5cc. to 10cc. of hydrogen peroxide (10 vol.). Experience soon showed me that under these conditions methyl orange could not be trusted as an indicator, and the cause soon became apparent. My object was to obtain sodium sulphates and nitrates only in solution, and with that in view I added excess of hydrogen peroxide to oxidise up all sulphurous and nitrous acids to sulphuric and nitric acid; but in the presence of an alkali the oxidation of nitrous to nitric acid is by no means complete, it is only partial; nitrite of the alkali will exist in solution in greater or less quantity, according to the varying proportions of sulphurous, sulphuric acids, and oxides of nitrogen present in the exit gases. In many cases the proportion of nitrite is so small as not to affect the working of the indicator; but when the sulphur acids escaping are low, and the acidity is due almost entirely to nitrogen oxides, then the failure of the indicator is frequent.

Under these circumstances, I abandoned the mixture of caustic soda and hydrogen peroxide as an absorbent, and found I could implicitly rely on the latter alone, sulphurous and nitrous acids being immediately and completely oxidised and, as regards the oxides of nitrogen, retained in solution more completely than when caustic soda alone is used. From that time I have never known the indicator to fail, even in solutions containing free sulphurous acid—*i.e.*, where the hydrogen peroxide was insufficient in quantity. As I understand Mr. Ballard uses caustic soda alone as an absorbent, I can readily understand the failure of the indicator in the testing of chimneys into which are draughted the exits of vitriol chambers, of which, under normal conditions, the oxides of nitrogen form a considerable part of the total escape.

I may be asked for further proof of the statements herein made. Direct experiment with sodium nitrite had already proved to me the change in the constitution of the indicator caused by free nitrous acid; but confirmation was desirable, and the usual tests for nitrous acid were inadmissible in the presence of excess of hydrogen peroxide, which produces similar reactions. Recourse was had to metaphenylenediamine, and the Bismarck-brown formation with nitrous acid. Nitrite of sodium in neutral and alkaline solutions mixed with excess of hydrogen peroxide showed that nitrous acid still exists as such, and that even in acid solution the oxidation requires some minutes for its completion.

DISCUSSION.

Mr. THOMSON asked what effect nitrous acid had on the methyl-orange indicator?

Mr. FORBES CARPENTER, in reply, said that instead of the usual change from orange-yellow with alkali to pink with acid, the orange changed to golden-yellow, and the eye could not detect the point of transition. After a time, this golden-yellow faded to a colourless solution. As regarded the nature of the change alluded to by Mr. Thomson, while it was probable that a further azo-compound was formed, yet the bleaching showed that this was by no means permanent. It would be most difficult to ascertain the ultimate constitution of the body formed by the reaction of nitrous acid on methyl-orange—dimethyl-aniline-azobenzene sulphonic acid.

METHOD FOR THE DETECTION OF ROSANILINE SALTS AND SULPHONATED ROSANILINE.

BY A. LIEBMANN AND STUDER.

H. SCHIFF (*Compt. rend.* 64, p. 487) found that by treating dilute aqueous solutions of rosaniline salts with sulphurous anhydride, nearly colourless, or rather pale yellow products are obtained, which he called rosaniline sulphurous acid. He further observed that these bodies when brought in contact with a trace of aldehydes show a very intense violet colouration, distinctly different from the original colour of the rosaniline. S. G. Schmidt (*Ber.* 14, p. 1848), who studied the reaction in late years, confirmed its general application and showed that acetone produced the same reaction. The authors further suggested that this test might be used for the detection of aldehydes or acetone, and some months ago when examining a urine from a case of coma diabeticum for acetone, which Professor Dreschfeld, of the Owens College, was kind enough to let us have, we found this test exceedingly delicate, the

rosaniline sulphurous acid showing at once, even with minute traces of the ketone, a deep violet colour. Only last Friday Professor Dreschfeld, to whom we feel deeply obliged, sent us another urine from a man suffering from the same disease, and the application of the reaction proved again very successful. P. Chantard (*Bull. Soc. Chim.* 45, pp. 83-86) used quite recently this reaction for the same purpose, and we are able to confirm throughout this author's statements. This test is of course only applicable to the discovery of a class of chemical compounds—to ascertain what special member we have to deal with, other experiments have to be made.

But we discovered that this property of the aldehydes and the acetone can be, *vice versa*, applied for the detection of rosaniline salts and sulphonated rosaniline. We have tested dyestuffs, wines, and lozenges in this way, and it might be of interest to state here that if, for instance, cudbear contains only one-fortieth per cent of magenta, it produced, after a certain treatment, a distinct reaction with acetone. To test for magenta or sulphonated magenta in cudbear we proceed in the following manner. One gram. of the dyestuff is boiled with 100cc. of water, and after cooling saturated with sulphurous anhydride. Most of the cudbear is precipitated by sulphur dioxide. The magenta or sulphonated magenta remain, however, entirely in solution—not as such, but in combination with sulphurous acid. If now acetone be added to this solution, and magenta or acid magenta is present, the colour turns after a few minutes' standing into a violet, while genuine cudbear does not show any change of colour. As before mentioned, we were able to show quite distinctly the presence of one-fortieth per cent of magenta; one-tenth per cent. produces quite a deep violet, and though the cudbear solution itself is of a pale red, yet there can be no doubt left about the presence or absence of magenta or acid magenta in it. To determine if cudbear contains a rosaniline salt or the sulphonated compound, we boil the solution after being saturated with sulphur dioxide and the precipitated cudbear being filtered off, dye a piece of cotton in it, mordanted in the ordinary way with tannin and tartar emetic. Only magenta will be fixed to the vegetable fibre, and we can readily ascertain which of the two is present.

In order to examine red wines for these colours we evaporate 100cc. to about one-tenth of their volume, saturate with sulphurous acid, and precipitate the natural colour by means of lead acetate. Acetone is added after filtration, and if the wine contains as little as one miligram. in the litre the test answers admirably. It is not necessary to precipitate the natural colour, for even if it remains the test leaves no doubt about the presence or absence of magenta and sulphonated magenta, but for the sake of a greater accuracy we prefer to proceed in this manner.

In the same way lozenges are tested for these colours, and the result proves that the reaction answers equally well in this case, and that the presence of sugar does not interfere with it, which was, however, made quite certain by S. G. Schmidt's researches on this subject.

Before concluding, we want to make some theoretical remarks about the constitution of these compounds. The constitution of the rosaniline sulphurous acids is probably analogous to that of Pira's thionaphthamic acid (*Ann.* 78, p. 51). In this body one H of the amido group is supposed to be replaced by SO_2H , the free acid decomposes readily into α -naphthylamine and sulphuric acid. The rosaniline sulphurous acid might contain SO_2H instead of H in the amido group; when this compound is boiled the original rosaniline salt is re-formed,

and sulphurous acid is driven off. Now the presence of the residue SO_2H might facilitate the condensation between the rosaniline and aldehydes or acetone. Experiments to prove this assertion will be made, and published at some future day. Schmidt's observations that methyl- and ethylalcohols produce also a very slight reaction, seems to contradict our theory. But then he could only detect a very slight change of colour, and this might be due to some impurities in the alcohols he used, though they had to undergo a very careful purification. We shall repeat his experiments with perfectly pure products. Other colouring matters containing the amido group shall be submitted to the action of SO_2 , and aldehydes and acetone, and we hope to be able at some future day to lay the results of our experiments before you.

DISCUSSION.

Mr. THOMSON said that he had noticed in the last number of the *Journal of the Society of Dyers and Colourists*, a process by Dr. Knecht for the detection and estimation of rosaniline salts when mixed with such colouring matter as cudbear or archil. Dr. Knecht experienced great difficulty at first in finding any process for the detection of rosaniline colours when mixed with archil; but he afterwards devised a process only differing from that described by Mr. Fairley (*see present issue*), in the use of caustic soda in place of ammonia to dissolve out the natural colouring matters of archil. He then treated the residue with acetic or hydrochloric acids to develop the colour of the rosaniline salts. Dr. Knecht subsequently found that this method had already been worked out by Mr. Crossley. He considered the test with dyeing up cloth previously bottomed with chrysamine to be a good, though not very delicate, one for rosaniline colours. Dr. Liebmann's process, however, seemed to be far superior to any of those mentioned for the detection of minute quantities of the colour.

The CHAIRMAN asked if rosaniline and sulphurous acid really formed a chemical compound? The action of aldehydes on this body reminded him of Lauth's reaction, on which about twenty-two years ago the preparation of "aldehyde green" was based.

Dr. LIEBMANN, in reply, said he believed that a combination took place when sulphurous acid acted on rosaniline, and that probably the first stage of preparing "aldehyde green" was analogous to the action of aldehydes on rosaniline sulphurous acid. Further experiments would, however, tend to explain the relation between the two compounds.

Birmingham and Midland Section.

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Notices of papers and communications for the meetings to be sent to the Local Secretary.

ERRATA.—In April issue, for "Warrington" read "Warrington" in the following pages—p. 214, 2nd col., line 12 from foot of text; p. 215, 1st col., line 15 from foot of text; and p. 216, 1st col., line 5. On page 214, 2nd col., line 7 from foot of text, after "spirit" insert "of wine." On page 215, 2nd col., line 23, for "methylic" read "methylic;" on same page and column, 15 lines lower, for "iodoformic" read "iodoform."

Meeting held at Mason College, April 7.

DR. TILDEN IN THE CHAIR.

THE CHEMISTRY OF FOUNDRY IRON.

BY THOMAS TURNER, ASSOC. R.S.M., F.C.S.,

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CAST-IRON is by far the cheapest and most abundant form in which the metal is obtained. It combines with a strength amply sufficient for many applications, the property of being readily manufactured by fusion into any required shape; it also possesses exceptionally high crushing strength, and being protected by a skin, is less liable to rust than either wrought-iron or steel. But it has some well-known disadvantages when compared with iron or steel. It is brittle, deficient in malleability and ductility, and possesses a comparatively small tensile strength. Castings are also liable to be somewhat untrustworthy, owing to unsoundness in the interior, and to irregular contraction during cooling.

Of late years, owing partly to these disadvantages, and largely to reduced prices of iron and steel, cast-iron has been superseded for many purposes, as a constructive material. And it has even been supposed by some that cast-iron will be rapidly replaced by steel for foundry purposes. But this idea is disproved by Mr. Head, in his address delivered at Lincoln last year, as President of the Society of Mechanical Engineers (Proceedings, 1885, p. 325). Mr. Head states that steel castings have the disadvantage not only of increased prime cost of material, but in greater loss during casting and cost of moulds, while the annealing process also involves loss of time and extra expense. On the other hand, good iron castings have fine surfaces, sharp edges, and a pleasing appearance. They are also less liable to contain cavities or blow-holes, and as they do not require annealing, they can, when necessary, be quickly produced to meet a pressing emergency. Mr. Head also states that for wearing surfaces nothing works better than cast-iron upon cast-iron, if only sufficient area be provided; and concludes that the art of iron-founding is in no danger of extinction, or even of serious diminution.

Owing to the attention which has been devoted to the study of steel during the last thirty years, the chemistry of cast-iron has not received the attention it really deserved, and consequently little has been done to elucidate the many problems which are as yet unsolved in this important branch of metallurgy. The present paper is an attempt in some measure to aid in this work. It deals with the determinations of the average strength of pig-iron, and briefly, on what chemical characters that strength depends. An account will be given of the methods usually adopted for increasing the strength, or improving the working qualities of cast-iron, and a description of some special processes which appear to possess certain advantages. An endeavour will be made to indicate how metal of any desired strength and working qualities may be obtained, and how by the application of established facts the cast-iron produced in this country may in many cases be very considerably improved.

THE STRENGTH OF CAST-IRON.

Before an accurate opinion can be formed of the mechanical value of a specimen of cast-iron, it is necessary, at least, that the tensile and crushing strengths, together with the relative hardness, should be known. Unfortunately, however, in the published

researches on this subject we are seldom supplied with the requisite data, and we are obliged to rely in great part upon the tensile strength, which, as was shown in the Report of the American Commission on Metal for Cannon (1856), may usually be taken as an index of the character of the metal.

The average tensile strength of British pig-iron is probably about 7.5 tons per square inch. It is subject to considerable variation, the limits being from 4 to nearly 15 tons. These results are not founded upon recent work, and it may be well to give a brief account of the authorities for the above statement, as the conclusions are of considerable importance in connection with other parts of the present paper. The earliest well-known writer on this subject was Tredgold,* who from the observed transverse strength, *calculated* the tensile strength of cast-iron at from 18 to 22 tons per square inch. It was pointed out, however, by Hodgkinson, in a later edition of this work, that Tredgold's calculation was erroneous, and that he had over-rated the tensile strength (4th Edition, 1860—61, pp. 231 and 285).

The well-known French authority, M. Navier, had also calculated the tensile strength of cast-iron, but upon a somewhat similar assumption to that made by Tredgold, and with little better success. However, in his "*Application de la Mécanique*," Navier published the results of some direct experiments made in 1815 by Minard and Desormes, to determine the tensile strength of cylinders of cast-iron, and these are the earliest experiments of the kind with which I am acquainted. The results obtained, when transferred into tons per square inch by Hodgkinson (Tredgold, 4th Ed. p. 230), agree very well with the average tensile strength observed by later English investigators. Thus, the maximum value obtained was 9.08 tons; the minimum 5.09 tons; and the average 7.19 tons.

In 1837 Messrs. Hodgkinson and Fairbairn published the results of a series of tests upon British irons, and by direct experiment obtained a maximum value of 9.76 tons; minimum 6 tons; average 7.46 tons (B. A. 7th Report, 1837, p. 339). In 1849, further experiments were undertaken in connection with the Iron Commissioners' Report; and, with specimens of increased diameter, Hodgkinson obtained a maximum value of 10.5 tons, and a mean of 6.8 tons (W. Pole: "*Iron as a Material for Construction*," p. 79). In 1858 a valuable report was issued, entitled "*Cast-iron Experiments*," containing the results of tests conducted at Woolwich upon about 70 specimens of British pig-iron. As a result of about 850 tensile tests performed, the maximum value obtained was 15.3 tons; the minimum 4.2 tons; and the average (of 51 samples, including several hundred tests) nearly 10.4 tons. This result is higher than those previously mentioned, and is due, probably, not to any improvement in the quality of pig iron, but to the care exercised in remelting and casting, and also to the fact that the specimens were supplied by the manufacturers in answer to an advertisement which appeared in the public press. It is probable, therefore, that the average tensile strength of about 7.5 tons per square inch, previously suggested, may be taken as a fairly representative value for British pig-iron.

It is of importance that the crushing strength should bear a suitable proportion to the tensile strength, when an iron of good mechanical properties is required. In the Woolwich experiments of 1858, the mean ratio is about 4 : 1, while the mean of Mr. Hodgkinson's experiments give about 6 : 1. The first

* T. Tredgold: "*Practical Essay on the Strength of Cast-iron and other Metals*," 1822.

of these ratios is generally taken by engineers as a fair average value. With a low ratio the metal is weak and soft; with a high ratio it is hard and brittle.

FOUNDRIY MIXTURES.

It must be remembered that in the cases we have hitherto mentioned, certain brands of pig-iron were examined without mixture. Hence these results give only the groundwork upon which to build, since cast-iron is very seldom employed in this state for foundry purposes. It has been found by long practice that certain mixtures of iron produce a better result than any single brand alone. By suitable mixtures it is possible to greatly increase the strength of the material, and to produce iron of a character more or less suited for the purpose in view. For an account of the mixtures of iron employed for foundry purposes by various manufacturers throughout this country, the Report of the Commissioners on Iron for Railway Structures, 1849, p. 418 *et seq.*, should be consulted, where directions are given as to the proportions of different brands of iron to be employed for large and small castings, and it is interesting to notice how little foundry practice has changed during the last 40 years. But it is lamentable how little real knowledge of the constituents present is commonly possessed by those who make these mixtures of iron. Quite recently I was assured at a large foundry that the principles were only to be learned by long experience, and that they worked entirely by "the rule of thumb" in their mixtures. In these times of sharp competition it is certainly important that accurate knowledge should be used in the iron foundry.

In 1846-47 Mr. Robert Stephenson conducted some experiments in connection with the erection of the high-level bridge at Newcastle-on-Tyne. The object was to determine, by the transverse strength of the product, the most suitable mixture of cast-iron for the construction of the girders of the bridge. Among the conclusions arrived at were the following:—

1. That simple samples did not run so solid as mixtures; further, that they are sometimes too hard and sometimes too soft for practical purposes.

2. That mixtures of hot and cold blast together gave a better result than either separately; though hot blast iron alone was not much inferior to cold blast iron alone (W. Pole: "Iron as a Material for Construction," p. 88). But though Stephenson showed that a considerable improvement in the quality of pig-iron might be made by suitable mixtures, he did not succeed in obtaining anything like that maximum value which has since been proved possible. Some of his conclusions also can only be regarded as true under the circumstances of the experiments in question. The most noteworthy example of what may be done in this direction is illustrated in the American Report on Metals for Cannon (1856), which shews that during the 10 years ending 1851, the average tenacity of metal in cast-iron guns was increased by about 60 per cent; and this improvement was obtained, not by adding any new substance to the iron, but by increased care in mixing and founding. At this period, just before cast-iron began to be superseded as a material for the construction of ordnance, the mixing of cast-iron was wonderfully well performed in the American Government foundries. Thus Lieut. Wallack, in his Final Report on the Quality of Cast-iron for Cannon, p. 326, recommends that the *lowest* limit of tensile strength for guns of superior quality should be 24,500 lb. per square inch, or about 11 tons, which is rather higher than the *maximum* tensile strength ever recorded by Mr. Hodgkinson in pig-iron. It should be mentioned that guns were

regularly cast of the desired quality, many of them considerably exceeding this lower limit of about 11 tons, and in one case a tensile strength of 20·5 tons is recorded.* This latter number has been somewhat doubted by certain authorities, but no valid objection can be raised to the result. It must not be compared with British experiments, as the latter have been conducted almost entirely on pig-iron. It is not an isolated result, but the maximum of a number of excellent specimens. I have myself obtained a tensile strength of 15·7 tons, and do not doubt but that with suitable precautions a still higher value could be obtained.

It is evident, therefore, that the iron-founder who aims at obtaining a tensile strength of 15 tons, as measured by a test-bar 1 inch in diameter, is aiming only at that which may, by suitable care, be obtained. And it can be shown, further, that the crushing strength may be increased in a similar proportion, while a metal of fair or good working qualities may be produced. At present the majority of manufacturers are content with a tensile strength of about 9 tons, and to aim at an increase in strength of 66 per cent. may seem bold, but I believe this could certainly be obtained in many cases. It is not to be done by the employment of new and expensive material, but by the proper use of that which we at present possess. Cast-iron should, however, be produced with a due regard to chemical and mechanical principles, and some of these we will proceed to discuss.

CHEMICAL PRINCIPLES.

The mechanical properties of cast-iron are very much influenced by the nature and amount of the various constituents it contains. The most important of these, and the one usually present in the largest proportion, is carbon; and this cannot be regarded as an impurity in cast-iron. The influence of the form in which carbon occurs is very great. Thus, white iron, which contains scarcely any graphite, is hard, brittle, and often unsound; while very grey iron, in which the carbon is almost entirely graphitic, is soft and weak. It has been known, for probably at least a century, that the strongest variety of cast-iron is produced from a material which is close-grained grey, and therefore intermediate between these two extremes. This was the material, especially when rather inclined to mottled, which was formerly so much preferred for gun founding†; while if a little more inclined to white, it possesses the highest crushing strength. If, on the other hand, it is a little more grey, it is a good working iron, though perhaps weak.

Any of these grades of iron can be produced at will, and with considerable regularity, by careful management of the blast furnace. But it is well known that during remelting, either in the usual method by the cupola, or in an air furnace, the character of the iron is considerably modified. It is occasionally rendered softer by fusion, but more commonly it is hardened, the action depending on the character of the original material, and the chemical changes produced during melting. Further, it is known to practical founders that irons which, as judged by fracture, are of the same grade, often vary considerably in hardness and working qualities. On these accounts it is hopeless for the present at all events, to expect that pig-iron can be made at the blast furnace, so that on remelting it may produce, without mixture, the best class of castings. What may be expected, however, is an iron

* 45,370 lb. per square inch: American Report, p. 279.

† Karsten says that for this purpose "pig-iron should be neither too grey nor too white, either of which is equally injurious."

tolerably near in properties to that which is desired, and which may be rendered harder or softer, tougher or weaker, as may be required. This should be done by mixing upon definite principles, and not simply by "rule of thumb." It is generally considered sufficient, in mixing iron, to say that a certain hard or soft iron, as the case may be, imparts much of its own "nature" to the mixture. But we want to know *more* than this; we want to know *why* a certain iron is hard, and another soft, and upon what chemical principles we should proceed to most readily and surely convert the one into the other. This can only be accomplished by a knowledge of the exact influence of each and all of the constituents present in cast-iron.

INFLUENCE OF OTHER CONSTITUENTS.

The most important constituents of cast-iron, other than carbon, are manganese, phosphorus, silicon and sulphur. Each of these elements, when present together with carbon, has a definite influence on the amount of graphite in the product, tending either to increase or decrease the proportion of combined carbon. They have each, doubtless, in addition, an influence due to their own presence in the material, though we are at present ignorant of the nature of this latter effect. Hence, each element by its presence produces two effects, one due to its influence on the carbon, and a second due to its action on the iron itself; the first of these is known, and is probably the most important, while the second is at present almost unknown.* And, for practical purposes, we may probably regard the influence of each element on the proportion of graphitic carbon, as being in some measure an index to its effect on the properties of the product.

Each of the four elements previously mentioned, when present in considerable proportions, causes the iron to be practically worthless for foundry purposes; but when present in small quantities they fall naturally into two classes, according to their influence on the proportion of graphite.

1st. Manganese, sulphur, and phosphorus, which tend to produce white iron, by reducing the amount of graphitic carbon.

2nd. Silicon, which increases the proportion of graphite, and so produces grey iron.

We shall now consider each of these classes separately.

I.—MANGANESE, SULPHUR, AND PHOSPHORUS.

Though phosphorus has been placed in this class, to which it most probably belongs, evidence is still wanting before its place can be considered as quite definitely fixed; in the case of manganese and of sulphur, however, there is no doubt.

Spiegeleisen is a familiar example of a white iron produced by the presence of manganese; while the works of Percy, Bell, and others contain proof that the addition of sulphur to cast-iron produces white metal. Hence where combined strength and softness are required, it is important that the proportion of these elements should be small. As to the maximum limit in each case, we have at present little evidence, and upon this point I hope to enter into more detail at a future time. But at present I am inclined to recommend that for best qualities of foundry iron the proportion of sulphur should not exceed 0.2 per cent.; phosphorus, 0.5 per cent.; and manganese, 1.0 per cent. In exceptional cases, where other elements

occur in unusual amounts, these values may be modified, but for general purposes they will probably be sufficiently accurate.

In speaking of the production of white iron it is necessary to say a few words regarding chill casting. This, as is well known, diminishes the proportion of graphite, and produces a white iron. There is, however, only a certain class of irons which are subject to this effect, and I have already elsewhere considered the causes for this fact (*J. Chem. Soc.* 1885, p. 913). It must, therefore, be remembered that in the present paper, except where expressly stated otherwise, I am considering iron when cast according to ordinary foundry practice.

II.—SILICON.

Silicon was formerly regarded as a hurtful ingredient in cast-iron, when present in any proportion, great or small. As an exception to this general condemnation, the following remarks from Watt's Dictionary, vol. iii. p. 334, are worthy of note: "It is generally considered that, within the ordinary limits as to the amount of silicon in cast-iron, this substance does not exercise any prejudicial influence upon the quality of the metal." It is somewhat remarkable that this opinion should have been so general, when it was well known that "refined metal" differed from grey pig, chiefly in the absence of silicon, and that in spite of its greater chemical purity it was inferior in mechanical properties in almost every respect.

It had also been shown by Mr. Clarke, in an extensive series of experiments in connection with the suspension bridge across the Danube at Pesth, that Austrian and Hungarian charcoal irons, which are low in silicon, are somewhat deficient in tenacity, as compared with British iron (Mallet, p. 29). And Messrs. Hodgkinson and Fairbairn had compared together the mechanical properties of irons smelted from the *same ores*, but using respectively hot and cold blast. They found very considerable variations in the specimens tested, but the average transverse strength of iron smelted by hot blast, was 2.5 per cent. higher than when cold blast was used; and the average power of hot blast iron to resist impact was 22.63 per cent. greater than that of cold blast. It has since been proved that the chief difference between hot and cold blast iron, is the higher proportion of silicon in the former; and these results, therefore, do not by any means support the popular objection to the presence of silicon in cast-iron.

I have, however, recently shown that silicon, when added to white cast-iron, causes a separation of graphitic carbon, thus producing a soft grey iron.† It follows, therefore, that when present in suitable proportion, silicon produces an improvement in the qualities of the metal; and it is now very doubtful whether silicon, when present in moderate quantity, should be regarded as an impurity in iron intended for foundry purposes. A short account of the effect produced by different proportions of silicon may not be inappropriate here.

1. *White Iron* almost invariably contains under 1 per cent. of silicon, and in very many cases less than 0.5 per cent. In cases, however, where either sulphur or manganese occurs in more than usual quantity, iron may still be white, though it contain upwards of 1 per cent. of silicon.

2. *Mottled Iron* often contains about one per cent. of silicon, though this amount is subject to considerable variation, the more usual limits being from 0.4 to 2 per cent. In this variety of iron the proportion of sulphur appears to be of great importance, very

* There is yet a third effect, due to the influence of the different elements upon each other. At present we have practically no information whatever upon this point; it is probably of comparatively little importance, and so may be neglected.

† T. Turner: *J. Chem. Soc.* 1885, pp. 577, 902; 1886, p. 130. C. Wood: *J. Iron and Steel Inst.* 1885, ii. p. 164.

small variation causing considerable difference in the product.

3. *Grey Iron* is almost exclusively used in the foundry. It may be roughly divided into three classes, according to the properties which are most marked.

(a) *Crushing Strength*.—Irons which possess the maximum crushing strength are usually silvery grey, or very close-grained in texture; they are hard to the tool, and deficient in tenacity, and hence are only suitable for special purposes. For example, it has been shown by tests at Shoeburyness, that cast-iron shot which possesses the greatest crushing strength has also the maximum penetrative power, and it is found that this can be obtained most readily when the proportion of silicon is about 0·8 per cent.; this is also the proportion which produced the maximum crushing strength in my own experiments (*J. Chem. Soc.* 1885, p. 912). For the manufacture of rolls or other very hard castings, about 0·8 to 1 per cent. of silicon is probably best.

(b) *General Strength*.—Irons which possess the greatest general strength are tolerably close-grained, and of uniform texture. They are softer than the class last mentioned, and of smaller crushing strength, but their tenacity is greater. Their ratio of crushing to tensile strength is in good proportion; and they are sufficiently soft to be worked with tolerable facility. They generally contain about 1·4 per cent. of silicon, the usual variations being $\pm 0\cdot5$ per cent., and depending chiefly on the proportions of other elements.

(c) *Softness and Working Qualities*.—It is often more important to obtain a good working iron than to have one possessing considerable strength. Soft irons are darker in colour, and more open in fracture than those previously considered. Their crushing strength is often less than one-half of that of the first-class, though their tenacity is sometimes much greater; but they vary very considerably in strength. Their carbon is almost entirely graphitic, and they usually contain not less than 1·8 per cent. of silicon. The maximum limit for ordinary purposes is probably 3 per cent., though for casting small objects or thin sheets, where fluidity is required, together with a smooth surface, and a grey iron, even this maximum may sometimes be exceeded.

It has been stated above that all the founder may reasonably expect to be produced, by the blast furnace, is an iron tolerably near in properties to that which he desires, and that this product should be softened or strengthened as may be required. It will be obvious that in the majority of cases, this may be readily and economically accomplished by a suitable alteration in the proportion of silicon. Thus an iron which is too soft may be strengthened by reducing the amount of silicon, while an iron that is too hard may be softened by increasing that amount.

This simple statement is in a measure new, because silicon has been hitherto regarded as an element whose presence was undesirable in cast-iron. But while the importance of silicon has thus been theoretically denied, it has been long practically recognised by the experienced founder. For it can be shown that the soft, good-working iron, produced by an experienced founder, usually contains about 2 per cent. of silicon, and little more than a trace of sulphur, and as a result the combined carbon present does not exceed a few tenths per cent.

There are, however, a few well-marked examples of the effects produced by alterations in the proportion

of silicon which are worthy of detailed examination, and which are none the less interesting because the facts upon which the effects depended were generally either misinterpreted or overlooked.

STIRLING'S TOUGHENED CAST IRON.†

The late Mr. J. D. Morris Stirling took out four patents in all, between the years 1846 and 1851 inclusive. They all referred either to metals or metallic alloys, and generally do not appear to have been much applied. In his first patent, however, taken out in 1846, a very important method for the production of "toughened cast-iron" is mentioned. Thus in the specification, p. 3, he says: "For certain purposes, such as shaftings . . . where a metal possessing greater tenacity or strength than ordinary cast-iron is required, and where it is an object to vary the degree of hardness, I made a mixture of wrought and cast-iron. . . . I melt cast-iron . . . and add to it . . . a quantity of malleable iron less than the weight of the cast-iron. . . . This mixture is afterwards to be re-melted as convenient. . . . And I would remark that the cold blast-iron, or iron containing the lesser quantity of carbon, will require a smaller addition of wrought iron than hot blast-iron, or iron containing a larger quantity of carbon; but I find that the addition of 1-3rd to 1-5th of wrought-iron to answer well in the generality of cases where increased strength, toughness, and tenacity are required."[†]

Stirling appears here to be quite clear upon two points—namely, that not more than one-third of wrought-iron should be added, and that this amount would depend, at least to some extent, upon the character of the iron employed. But he does not appear to have been equally clear upon the cause of the undoubtedly good effect which resulted in many cases. It was apparently sufficient to know that cast-iron was of a brittle nature, and wrought-iron tough, so that wrought-iron imparted some of its tough nature to the mixture. The remarks in the specification, as to the difference in carbon, cannot be regarded as more than a statement of a supposed fact, and not as an explanation of it. We now know, however, that practically the only difference between hot and cold blast-iron is that the former is more highly silicious, which accounts for the fact that this class of iron required a larger proportion of wrought-iron to produce the best effect.

Mr. Stirling had two chief objects in view—namely, to increase the strength of soft irons, and to make a uniform product, from the iron of different districts, which should not be under a given strength. The process was, therefore, not applicable to hard irons, which were actually deteriorated by any addition of wrought-iron. It was also found that with soft irons there was a definite limit, depending on the material, which could not safely be exceeded. Thus it was found in one case that on mixing—

100 parts of cast-iron with 10 of wrought, the transverse strength increased 22½%.
100 parts of cast-iron with 20 of wrought, the transverse strength increased 31½%.
100 parts of cast-iron with 30 of wrought, the transverse strength increased 60%.
100 parts of cast-iron with 40 of wrought, the transverse strength increased 33%.

† For fuller details see—Patent 11,262, 1846: "Toughened cast-iron," etc. Report of the Commissioners on Iron for Railway Purposes, 1849, p. 415 *et seq.* Inst. C.E., xi, 1851–2, p. 238; xviii, 1859, p. 339. Inst. M.E., 1853, p. 19 (an important paper by Stirling himself). W. Fairbairn: "Application of Iron to Building Purposes," 1857–8, p. 68. T. Box, "Strength of Materials," 1883, pp. 202, 503, etc.

Some similar experiments were conducted about the same time by Mr. Lillie, of Manchester. Greatly increased strength was obtained, but the experiments appear to have been abandoned after Stirling took out his patent.

It should be explained that the term "general strength" is used to indicate an iron possessing a good transverse strength, combined with fair crushing and tensile strength and moderate hardness; properties which would render it useful for a large number of applications.

Showing that the maximum result was produced with about 30 per cent. of wrought scrap.

Unfortunately I am not aware of any chemical analysis published in connection with Mr. Stirling's work, but a little consideration will make plain the causes of the result obtained. Thus an average hot blast soft foundry iron may be considered to contain about 3·5 per cent. of carbon, and perhaps 2 per cent. of silicon, or probably more. On mixing this with one-third of its weight of wrought-iron, these numbers would be reduced to about 2·6 for carbon, and 1·5 for silicon; and from what has been already stated as to the effect of silicon on cast-iron, it is evident that any further addition of malleable iron would render the metal both white and steely, and hence cause serious deterioration in its properties.

As to the method of applying this process, it was recommended that the mixture should be made at the blast furnace, by placing the metal in the moulds into which the molten cast-iron was to be run. The malleable iron was thus firmly fixed, and when re-melted in the cupola a uniform product was produced. This product appears to have been subjected to very rigorous and impartial tests, and to have yielded very satisfactory results. Thus the experiments of Messrs. Fairbairn, Hodgkinson, etc., give the following mean values * :—

Kind of Strain.	Stirling's Iron.	Ordinary British Iron.	Increase per cent.
Tensile, tons.....	12·46	7·112	74
Crushing „	55·7	43·00	30
Transverse, lb.....	3300	2063	60

The mean result obtained with “toughened cast-iron” was, therefore, considerably above the maximum value obtained by the same experiments with British pig-iron, as noted above.

Very satisfactory results were also obtained by Mr. Owen, the Government Inspector of Metals, who conducted some experiments on the strength of beams. For this purpose 13 beams were made of British irons, either alone or in mixtures, and 11 beams were also constructed, exactly similar, from the same irons, but with addition of wrought scrap. The results obtained were as follows, (Box, p. 202) :—

	Load.	Deflection.
Mean of 13, ordinary iron.....	38·3 tons	1·91
„ „ 11, Stirling's iron	52·3 „	1·81

giving an increase of load equal to about 37 per cent.

It will be seen that these values are considerably greater than those hitherto noticed in this paper, and mark a considerable improvement in the mechanical properties of British cast-iron.

“Toughened cast-iron” met with a considerable application during the lifetime of Stirling. Thus Mr. Slaughter used it for locomotive cylinders on the Great Western Railway, “and found it made very fine, perfect and sound castings, better than he had ever made before.” Among the larger applications may be mentioned Chelsea Bridge, Windsor Bridges, Yarmouth Bridge, and Manchester Viaduct. In the latter case Stirling says : “By being allowed to reduce the scantling in proportion to the increased strength gained by employing the toughened cast-iron, the contractors for the heavy castings were enabled to profitably fulfil their contract, whereas had they used common iron, and been confined to the specification, they would have been heavy losers.”

In view of these facts, it appears at first sight somewhat surprising that the addition of wrought-iron is

not more generally practised, at present, by iron-founders. The reasons for this are probably as follows :—

1. Cast-iron has been largely superseded by steel and wrought-iron for purposes where considerable strength is required.

2. Special care is necessary in order to secure a uniform and reliable product. Thus Robert Mallet, a founder of large experience, writing in 1856, says : “Want of assured homogeneity, especially in large masses, appears to be the objection to Stirling's patent toughened cast-iron.”—“Construction of Artillery,” p. 30.

3. Owing to the theory of the process being misunderstood, the results obtained were sometimes uncertain, as the effect was ascertained by trial and could not be predicted beforehand.

In spite of these disadvantages, however, it is probable that this process might be profitably employed in many cases. It can be economically applied in the case of cheap weak irons, rich in silicon, for the production of cast-iron possessing special strength. And the chemist should now be able to determine, from the analysis of the pig-iron alone, whether it could be much improved by the addition of wrought-iron scrap.

There are two other methods of strengthening cast-iron which depend upon the same principles as that of Morris Stirling, and which are worthy of a brief reference.

PRICE AND NICHOLSON'S PATENT (No. 2618, 1855).

“This invention relates to the production of a cast-iron of a strength much superior to that now manufactured, and therefore peculiarly applicable to the casting of ordnance, girders, etc. The main object of the invention is to lower the percentage of silicon in cast-iron, whilst the total amount of carbon remains the same” (Specification, p. 3). This object was attained by mixing “refinery metal,” the product of the refinery forge, with soft grey iron in suitable proportion. Although the patentees appear to have regarded silicon as being uniformly injurious, it is evident that practically they showed the contrary, in that they do not recommend the use of refinery metal alone, which in spite of, or rather by virtue of, its special purity, is unfitted for foundry purposes.

The method adopted by Dr. Price would appear to be founded on better chemical principles than that of Stirling, because in the present case it will be noticed that the carbon is kept practically constant, while the proportion of silicon varies. The effect produced by these mixtures would, therefore, doubtless resemble those noticed in my own experiments, except that they are over a smaller range, and in reverse order, since Dr. Price began with grey iron, and gradually added refined metal to it. I am not aware, however, that any regular series of experiments was performed, but the following account of tests by Sir W. Fairbairn is interesting (“Iron Manufacture,” 3rd. Ed. p. 229) :—

“The average strength of cast-iron has been found to be about 7 tons per square inch. But some tests of Dr. Price's compound mixture, used for specimens of cast-iron shot for experiment at Shoburyness, gave tensile strength—

	Tons.
Experiment 1	13·125
„ 2	11·714
„ 3	14·762
„ 4	15·189
Mean ...	13·697

* Box, p. 501.

or an increase of nearly 100 per cent. on ordinary cast-iron." The compression tests gave a mean of 57.37 tons per square inch, an increase of 43 per cent. on the mean of Mr. Hodgkinson's experiments. It will be noticed that the tensile strength observed in these experiments is very nearly double the average strength of pig-iron, and more than half that of wrought-iron (25-26 tons) as found in Kirkaldy's experiments. I believe that these values could be even exceeded by the ironfounder, who desires to obtain a strong iron, if only sufficient attention be paid to mixing.

USE OF STEEL SCRAP.

Steel scrap has been somewhat extensively used during the last few years, in America, as a means of strengthening cast-iron. Thus Samuel M. Carpenter produces strengthened cast-iron by immersing steel in liquid cast-iron (American Patent 173,159, February 8, 1876), claiming that by this method of mixture a better result is obtained. And Mr. Thomas D. West, the author of "American Foundry Practice," and himself an experienced founder, writing recently in the *American Machinist* (May 30 1885, p. 5), gives some directions for the proper use of steel scrap, and speaks favourably of the results obtained. It is employed to give greater strength or hardness, and to increase the depth of chill, being used for wheels, pulleys, and other work where these qualities are required. The process is evidently exactly similar in principle to that originally patented by Stirling, and depending, in a great measure, on changes in the proportion of silicon. It is fully recognised by Mr. West that too much steel has an injurious effect upon the mixture, for he says: "I would not have the reader understand . . . that the more steel or wrought-iron there is mixed with cast-iron the stronger will the mixture be. As far as strength is concerned . . . there is a limit to the percentage which should be mixed with cast-iron, and it greatly depends upon what grades of steel and cast-iron are mixed together. The cast-iron in some cases may not stand more than 3 to 5 per cent. of steel or wrought-iron in order to obtain the greatest strength." It might have been added that hard irons are rendered both harder and weaker by any addition of steel.

The three processes we have discussed, are undoubtedly very important and efficacious methods of strengthening a weak iron. Either wrought-iron, steel scrap, or "refined metal," when added in suitable quantity to a weak iron, will increase both the tensile, crushing, and transverse strength of the metal. And it may be pointed out that at the present prices in South Staffordshire, either wrought-iron or steel scrap might be profitably used where a strong iron is required. Taking "all mine" South Staffordshire foundry iron at £2 12s. 6d. per ton, medium wrought scrap at £2 5s. 0d., and steel scrap at £3, a mixture might be obtained at least equal to the best cold blast or hematite iron at £3, or upwards, with a saving of at least several shillings per ton. (N.B.—Prices are lower since this was written, some months ago.)

There are two methods of strengthening cast-iron, which are sometimes adopted, but which are open to more serious objection than those previously mentioned.

In the first place, remelting has been recommended for this purpose. The influence of this I have recently discussed at some length (*J. Chem. Soc.*, 1886, p. 147), so shall not now consider in detail. The effect produced by remelting is due almost entirely to chemical changes in the material, such as alterations in the amount of silicon and sulphur, and these changes can be more readily and cheaply produced by careful mixing than by continued remelting. Stress

has sometimes been laid upon the use of an air furnace instead of a cupola, for remelting. This involves extra trouble and expense, and the benefit is very doubtful, except in certain special cases. Secondly, the addition of sulphur is sometimes recommended, but I believe the use either of sulphides, or the addition of iron rich in sulphur, is open to several grave objections, which I have not space at present to discuss in detail; I hope, however, to be able to do so shortly.

But though it is important in some cases to be able to produce a very strong iron, in many instances we require a soft iron perfectly uniform in texture. This is of very great importance when the material has to be filed and turned, or otherwise operated upon by the workman. And at the present time it is probably much more important to be able to produce a soft iron from a hard iron, than to increase the strength of a weaker material. It is evident that for this purpose the addition of silicon is of the utmost value, since it is the only element commonly present in cast-iron which produces this effect. So far as I am aware, the fact that the addition of silicon to hard cast-iron produced a soft product, was first noticed in my own experiments (*J. Chem. Soc.*, 1885, p. 577) commenced nearly three years ago. But the fact has been confirmed, and some very interesting observations made in independent experiments by Mr. Charles Wood, of Middlesbro'.

As an example of this effect, I have prepared six specimens made by adding small, but gradually increasing quantities of siliceous iron to South Staffordshire "allmine" white iron, from Mr. Round's furnaces. It will be noticed that the samples pass gradually from white into grey iron as the proportion of silicon increases, becoming ultimately dark grey, and very soft to the tool, being in fact quite suitable for foundry purposes. This will at once suggest an easy and profitable method for the disposal of white iron and "glazed pig," each of which are commonly objectionable varieties of iron, to the smelter. By remelting one part of "glazed pig" with two or three parts of white or hard iron, the product obtained is grey iron, well suited to the use of the founder, and worth quite 5s. per ton more than the materials from which it was made.

In a paper read before the Iron and Steel Institute at its Glasgow meeting in September last, Mr. Wood gave an account of the use of siliceous iron for the purpose of softening hard Cleveland iron. His experiments were conducted on a considerable scale, from sixty to seventy tons being run per day during several months' working. And since the paper was read the use of siliceous iron has been continued with very satisfactory results, and it has also been applied by other founders, who speak favourably of its softening effects. I am indebted to the kindness of Mr. Wood for the following particulars, which have not hitherto been published.

The composition of the siliceous iron employed is as follows, the analysis being by Mr. Stead:—

Combined carbon	0.10
Graphite	3.15
Manganese	0.72
Silicon	4.48
Sulphur	0.01
Phosphorus	1.97

The above material, if used alone, would be hard and weak; it is low in price, and quite unsuited for making foundry castings; it is even less suited for use in the forge. But on mixing together half mottled iron, and half No. 4 foundry iron, with ten per cent. of siliceous pig, a grey iron was produced

which was very soft to the tool, and which gave beautiful castings. The castings contained

Silicon	2.33
Combined carbon	0.107

We see, therefore, that by admixture of three irons, each of inferior quality, and hard, when alone, we obtain a soft material, admirably suited to the founder's use. The mottled and hard foundry irons were hard through a deficiency of silicon, while the siliceous iron was hard for an exactly contrary reason. By suitable mixing a soft product results.

In Mr. Wood's paper an example is given of a mixture consisting of half Cleveland white iron, and half siliceous iron. The white iron contained about one per cent. of silicon and 3.3 per cent. of combined carbon. The siliceous iron closely resembled that I have previously mentioned. The product was analysed by my friend Mr. Walton, the result being as follows:—

Graphite	3.64
Combined carbon	0.14
Silicon	2.71
Phosphorus	1.53
Manganese	0.35
Sulphur	0.08

This iron gave beautifully close-grained castings which were soft, and could be cut easily by any kind of tool. The strength of the material was also increased, as measured by the transverse test on a three-foot bar, with a section of 2" × 1", the following values being obtained:—

Siliceous iron, alone	22.33 cwt.
White iron, alone	25.00 "
Mixture, $\frac{1}{2}$ white, $\frac{1}{2}$ siliceous.	30.33 "

or an increase of 27.7 per cent. on the mean strength of the original irons.

Another interesting use of siliceous iron for foundry purposes is seen in the casting of thin plates. For this purpose a No. 2 or 3 foundry iron is commonly used, and the plates are not unfrequently white even under these circumstances. But Mr. Wood is able to cast plates one-tenth of an inch thick, which are perfectly grey. This result may be obtained by mixing mottled and forge iron, and adding a suitable amount of silicious pig. By this means not only are grey plates capable of being regularly produced, but a cheaper class of iron is employed, and one which, unmixed, would be entirely unsuited for the purpose.

I may, however, remark here that while, when softness is the chief quality required in a specimen of cast-iron, special chemical purity does not appear to be of primary importance, still, when general strength is wanted, it would appear to be necessary not only that graphitic and combined carbon and silicon should bear a suitable proportion to each other, but that the proportion of other elements such as manganese, phosphorus, and sulphur, should be small.

In conclusion, the chief results arrived at in this paper may be briefly summarised as follows:—

1. The average tensile strength of British pig-iron is about 7.5 tons per square inch; but by careful mixing this value may be doubled.

2. The tensile and crushing strengths should be in due proportion, while the metal should not be unusually hard.

3. The proportion of graphitic to combined carbon furnishes an index of the general character of the metal. This proportion can be altered at will by varying the proportion of silicon.

4. Weak irons may be strengthened by adding either wrought-iron, steel, or hard iron of good chemical quality, such as "refinery metal." The use of impure materials is to be avoided.

5. Hard iron may be softened by the addition of silicon in the form of siliceous iron or silicon pig.

From the above facts it is evident that the mechanical properties of cast-iron may be varied at will by the application of definite chemical principles, and that the founder who mixes cast-iron without a knowledge of its composition, can only do so at the risk of producing a hard or weak material, indifferently suited to the purpose in view, and often at the cost of much unnecessary expense and trouble.

DISCUSSION.

The CHAIRMAN strongly recommended members to read the papers which the author had published in the Journal of the Chemical Society, and which contained the results of his experiments carried on during the last two years. Practically, the whole of the work had been conducted in the laboratory of Mason College, and it was to be hoped that the author would pursue his investigations still further. He fully concurred with Mr. Turner in condemning those who still resorted to "rule of thumb" as a guide, and urged, not only chemical manufacturers, but also ironmasters and workers in metal, to support such investigations as likely to yield useful results.

Mr. ROUND said that, in his remarks on the strength of pig-iron, the author had not alluded to the qualities used, or their sources. Irons from different localities varied much in character, each sample possessing certain desirable features, and it was quite possible to obtain an iron possessing a combination of these qualities by making suitable mixtures. Hematite pig was tenacious and tough, but did not work well alone; Cleveland pig was very useful, but weak. He recommended these facts to the consideration of those who were carrying out these investigations.

Mr. ROWLEY asked if the presence of more than 10 per cent. of silicon adversely affected the crushing and tensile strength of iron? He would also like to hear what chemical or mechanical reasons there were for the shape of the curve given?

Mr. HAINES asked whether the pig referred to was a normal production, or specially prepared? also whether it was cheap, and what effect it would have on the common white cinder pig of South Staffordshire?

Mr. TURNER, in reply, said that he fully recognised the importance of the point raised by Mr. Round and was only prevented from alluding to it by considerations of space. Where an account of the character of the iron used had been omitted, it would generally be found in the original papers to which references were given. He had not been able to carry his experiments beyond 10.3 per cent. of silicon, but this was ample for all practical purposes, and there was no doubt that the tensile and crushing strengths would continue to gradually decrease with more silicon, just as the density had been shown to do. The shape of the curve was probably due to the fact that it represented the resultant of two effects—namely: first, that of silicon on the iron itself; and secondly, that of silicon on the proportion of combined carbon. The latter, when graphically represented, gave a steep curve, with a maximum of 1–2 per cent. of silicon, while the former gave a curve which was probably more nearly straight. The two effects combined produced the curve in question (*J. Chem. Soc.*, 1885, 908). The Govan and Mostyn silicon pig, of which specimens were exhibited, were specially pre-

pered for use by the steel-maker. They often contained as much as 10 per cent. of silicon, and were proportionately dear. The Middlesbro' siliceous pig, for the specimen of which they were indebted to Mr. Charles Wood, was an ordinary product of that district, and cheaper. Some manufacturers in the Birmingham district were now prepared to sell siliceous iron by analysis at a cheap rate for use in the foundry for softening purposes. He had not yet tried silicon pig as a softener for common white cinder pig, but doubtless a soft iron could readily be produced in that way, though such material would be quite unsuitable for the production of cast-iron of high tensile strength.

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The Seventh Meeting of the Session was held in the Rooms, 207, Bath Street, on Tuesday, 4th May, 1886.

J. NEILSON CUTHBERTSON IN THE CHAIR.

ARSENIC IN SPANISH PYRITES, AND ITS ELIMINATION IN THE LOCAL TREATMENT FOR PRODUCTION OF COPPER PRECIPITATE.

BY H. B. FULTON, F.C.S.

In this paper, reference is restricted to the local treatment of pyrites at the mines, where, owing to the small copper content of the ore, the scale upon which operations are conducted is necessarily one of great magnitude, and where the evolution of sulphurous gas during calcination is such as would not be tolerated in any densely-populated neighbourhood, or in any agricultural district.

The more rational treatment, by what is known as the Henderson process—where the sulphur, iron, and copper, as well as the noble metals found in the pyrites, are separately recovered—though universally adopted for the treatment of Spanish pyrites in this country, is clearly inapplicable under the conditions existing at the mines.

The commercial success of the Henderson process depends, in no small degree, upon the utilisation of the sulphur of the pyrites, and on the recovery of the residue of purple iron after all the other metals have been removed from it; and while in this country the ores so treated have never a copper content of less

than 3 per cent., a large proportion of those treated locally does not average more than 2 per cent.

Further, without considering the greater cost of fuel at the mines, the enormous amount of sulphur in the mineral treated locally would, if recovered, more than supply the requirements of the world, and could not be disposed of: and in a country teeming with rich iron ore the purple iron residue would be comparatively valueless, and would in few cases bear the costs of removal and exportation.

The importance of this local industry may be realised when it is remembered that, in the Iberian peninsula alone, a quantity estimated at upwards of 20,000 tons of metallic copper is annually produced by the methods hereinafter mentioned from pyrites containing on an average less than 3 per cent. of copper.

Although there is considerable variety in the copper and arsenic contents of ores of this kind from different mines, or from the same mine, as selected for export or for local treatment, the following analysis of San Domingos export mineral, by Mr. F. Claudet, may be taken as an average of what has generally to be dealt with:—

Siliceous residue	0.63%
Sulphur.....	49.00
Iron	43.55
Copper	3.20
Arsenic.....	0.47
Zinc	0.35
Lead	0.93
Lime	0.10
Water	0.70
Oxygen and traces of various metals ...	1.07
	<hr/> 100.00

Here, then, in the crude mineral, the proportion of arsenic to copper is as one to seven, and it is evident that if the extraction of arsenic and of copper goes on proportionately and simultaneously, and that if, during some of the intermediate stages of the process, the arsenic be not more or less perfectly removed, a supposed resulting copper precipitate of 70 per cent. would be contaminated with the excessive amount of 10 per cent. of arsenic.

The condition in which the arsenic exists in the bulk of the mineral cannot be easily determined, either by microscopical examination or by analysis; and, indeed, in various specimens, it may be found in different forms. The prevailing form is probably that of mispickel ($\text{FeAs}_2 + \text{FeS}_2$). The greater part of the iron and of the sulphur occurs as iron pyrites (FeS_2), and the copper most probably as cupric sulphide (CuS), small quantities of copper pyrites and of copper-glance being more rarely met with.

I purpose giving here a brief outline of the various methods of local treatment, and will take in turn—Treatment of Ore by Calcination; Treatment of Crude Ore by Oxidising Solutions; Treatment of Crude Ore by Slow-weathering; and Treatment by a Combination of these three methods.

I.—LOCAL TREATMENT BY CALCINATION.

In most parts of Spain, where mineral of this class is found, calcination of the ore in open heaps is the usual and time-honoured method of dealing with it. Owing to the hardness and massiveness of the mineral—which occurs in enormous lodes, free from any visible matrix—dynamite is almost exclusively employed in blasting it, and, in consequence of the shattering power of this explosive, a large proportion of the ore is at once obtained in fragments of a convenient size for calcination. Hand-breaking of some of the larger pieces is resorted to, and the ultimate

result is, that while the great bulk of the ore is reduced to about road-metal size, something like 25 to 30 per cent. of it remains either as lumps (measuring 12 or 14 inches through) or as smalls from nut-size downwards. In this state, the whole is removed in waggons to the calcination-ground, and is there tipped over the bank for selection and distribution. From this bank the mineral is carried by boys and girls, or on donkey-back, to the site on which the heap for calcination is being prepared. No screening is necessary, since, in filling the wooden trays upon which the mineral is carried, or the esparto panniers by which the donkeys remove it, sufficient selection may be made of broken ore, lumps, or smalls as may at the time be required.

In the construction of a heap for calcination, a series of chimneys—the number being dependent on the size and disposition of the heap—are built up to a height of 12 or 15 feet, using for this purpose the larger unbroken lumps of mineral.

These chimneys communicate with one another and with the exterior, at intervals all round the base of the heap by means of a network of flues similarly constructed of lumps. The broken mineral is laid upon this base till the chimneys—which thus form the apex of an extended pyramid—are covered, leaving their shafts open as vents. The sides of the pyramid rise at an angle of about 50° from the horizontal, this inclination being sufficient to prevent mineral running down, even when exposed to heavy rain. To complete it, the heap has to be externally covered with small ore, to check the rapidity of the calcination, and prevent the fusion of the mineral in the heart of the pile.

When thus prepared, the heap is lighted by thrusting burning logs of wood up the mouths or openings of the flues. This, at considerable inconvenience to the workmen engaged in it, is carefully attended to for some days, until it is evident that the heap has been thoroughly ignited all round. For mineral, so rich in sulphur, no foundation of firewood is necessary.

A large number of heaps, adjacent to one another, are generally lighted at the same time, and the dense sulphurous fumes which, for many weeks or months, are emitted from them, preclude further careful examination of each one in detail.

As will be readily understood, perfect calcination is scarcely attainable in this way; but it must be remembered that, in this treatment, calcination to such a degree as is effected in the burning of pyrites for vitriol making is not desired. The ultimate extraction of the insoluble copper remaining in the washed residue thrown on the waste heaps, and existing either as undecomposed mineral, or as "kernels," is largely dependent on the slow oxidation of the imperfectly calcined mineral.

In addition to this semi-calcined ore, a proportion, varying from 2 per cent. to 8 per cent. of the total mineral of the heaps, has generally to be removed after the operation in a practically crude condition. This mineral is collected and may be reconstructed into heaps for calcination as before.

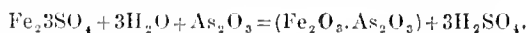
The proportion of uncalcined mineral thus separated depends considerably on the size of the heaps, and where these are small, with 200 tons to 500 tons, the ratio of superficies to weight is so great as to yield the maximum of unburnt ore; while, when the configuration of the ground admits of it, heaps containing 2000 tons to 3000 tons will allow of calcination with the minimum amount of crude ore.

While the apparent object of this calcination is the removal of the greater part of the sulphur of the pyrites as sulphur dioxide, and the conversion of the iron into peroxide, the real aim is to obtain as much as possible of the copper in the state of soluble

sulphate accompanied by a small quantity of soluble iron persulphate. During the progress of the calcination a considerable part of the arsenic is oxidised to arsenious oxide, much of it being in this state sublimed and dissipated in the air. A further portion is condensed on the exterior of the heaps, partly as oxide, and partly as sulphide, which appears in the characteristic shades of realgar and orpiment. Of these forms the only truly objectionable one in which, to the copper producer, the arsenic can here appear, is that of trioxide. As sulphide it remains practically permanently insoluble, and is not washed out with the copper either in the process of lixiviation in tanks, or yet from the waste heaps to which the washed calcined ore is ultimately consigned. As trioxide, however, it yields at once to the lixiviation in the tanks, and becomes dissolved along with the copper.

Under ordinary circumstances where the calcination process is legitimately carried out, the presence at this stage, of arsenious acid in the liquors causes no serious difficulty.

These effluent liquors from the lixiviation tanks contain, besides cupric and ferrous sulphates and free acid, a copious supply of ferric sulphates which give them a brown or yellowish green colour, according to their degree of concentration. Whether it be from the presence in excess of ferric oxide in the calcined ore, or from the already formed normal or basic ferric sulphates, the arsenious acid is readily converted into ferric arsenite, which remains soluble in the free acid:—



In the subsequent continuous precipitation of these liquors by means of pig or scrap-iron the ferric arsenite is precipitated only in the last tanks of a series, when, the greater part of the copper having been deposited, the free acid attacks and becomes neutralised by iron, and is no longer able to maintain it in solution. Hydrogen is freely evolved while the iron is being thus attacked, and the ferric arsenite becomes more or less completely reduced to ferrous arsenite.

The arsenic thus appears in the last tanks as a fine greenish white precipitate rendering the liquors—which in the first tanks had been clear and free from suspended matter—at first milky, and ultimately white and opaque. In this way it becomes mixed only with the final portion of copper precipitated, and may, in a great measure, be separated from it by a crude washing or jigging process owing to its lesser specific gravity.

Almost the last traces of ferrous or ferric arsenite may be removed from copper precipitate by washing it with a dilute solution of any mineral acid; but, unless for the richest precipitate, this treatment is not very often adopted. As a rule the precipitate, after draining for a day or two, is, in one operation, dried and calcined in reverberatory furnaces, with the view alike of removing any adhering graphite as well as the remaining arsenic. This latter result is, by such treatment, only very imperfectly accomplished, the greater part of the arsenic so removed being apparently carried over by the draught during the stirring of the charge, and is found deposited with the finer particles of copper in the adjoining dust chambers or flues.

II.—LOCAL TREATMENT OF CRUDE ORE BY OXIDISING SOLUTIONS.

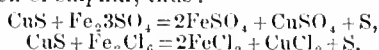
From the foregoing summary of the calcination process it will be seen that for the extraction of the copper in a soluble form, the treatment pursued is essentially one of oxidation. The cupric sulphide

submits to oxidation more readily than the iron pyrites, which practically fulfils only the office of fuel in the operation. Taking advantage of this fact, and with the view of diminishing the nuisance caused by the evolution and escape into the atmosphere of such enormous volumes of sulphur dioxide as are necessarily given off when the calcination process is had recourse to, works have, in some places, been established for the direct treatment of large quantities of crude ore by means of oxidising solutions which remove only the copper from the ore, leaving all the other constituents undisturbed.

Ferric sulphate, which can generally be obtained in abundance in dry weather as an efflorescence on old heaps of calcined ore, is most conveniently employed, and in some instances common salt is added so as to form ferric chloride or a mixture of ferric chloride and ferric sulphate.

The ore must be coarsely ground, since in the lump state it is impermeable to the solutions.

Under such treatment the cupric sulphide alone is oxidised with reduction of the ferric solution and liberation of sulphur, thus:—



and the effluent solutions for precipitation contain only cupric and ferrous salts, with perhaps a little unreduced ferric salt and soda salts, when chloride of sodium has been employed.

In this treatment, which is generally applied to fresh crude mineral, laid out in permanent heaps, there is no trouble with arsenic. It remains undissolved with the iron-pyrites, and the copper precipitate produced is free from any obnoxious impurity.

III.—LOCAL TREATMENT OF CRUDE ORE BY SLOW-WEATHERING.

Another mode of treatment which produces copper precipitate similarly pure, and which in Portugal—where calcination in the open air is entirely forbidden by law—is generally adopted, consists in exposing the crude lump mineral to atmospheric oxidation, in heaps, well ventilated by flues and shafts so as to induce *eremacausis* or slow combustion. Oxidation of the cupric sulphide principally takes place, the temperature never being allowed to rise sufficiently to drive off sulphur dioxide.

In the underground workings of these mines, where the mineral is exposed to the influence of air and moisture, the temperature generally rises, and it may be remarked that, notwithstanding the presence in excess of iron disulphide, the stalactites which gradually form, and, after a while, depend from the roof, are composed of cupric sulphate, with an almost inappreciable quantity of ferrous sulphate. The action which thus goes on in the interior of the mine, where the exposed surfaces are necessarily limited, is the same in kind as that which to a much greater degree takes place in the extensive heaps of crude lump ore, when the weathering process is adopted.

The soluble copper is periodically washed out of the heap, by flushing it with water, after which the whole heap, or a part of it, is allowed to rest for a while, so that, under the influence of air and moisture, further lumps of mineral may disintegrate and yield soluble copper before another flushing.

Solutions thus obtained contain only cupric and ferrous sulphate, and no contamination by arsenic takes place.

IV.—LOCAL TREATMENT OF MINERAL BY A COMBINATION OF THE PRECEDING METHODS.

In the hope of realising the advantages of each of the foregoing modes of treatment, a compromise,

embracing the essential features of all three, has been attempted, and it is under this treatment that the greatest trouble from contamination of the copper precipitate by arsenic arises, the arsenic appearing in its most malignant form.

When this treatment is adopted, the crude mineral is laid out in heaps, well ventilated by longitudinal and transverse flues, and with numerous vertical shafts in communication with them, precisely as for treatment by the weathering process. Common salt may or may not be mixed with the mineral. The weathering process is relied upon for the gradual disintegration of the lumps of mineral, and the cost of crushing it is thereby spared. In the weathering process, however, and especially after the flushing with excess of cold water, the mineral not unfrequently shows little disposition to begin reheating, often for months, and to meet this contingency, small clusters of crude ore are ignited round the upper part of some of the vertical shafts. These ignited clusters are isolated as carefully as possible from the great bulk of the crude ore in the heap, by surrounding them with a thick layer of previously calcined ore, and they are then covered up by crude mineral. Besides warming the adjacent mineral, they are supposed to assist the draught or influx of air by the flues below, and thus promote the weathering process.

Again, taking advantage of the facility with which cupric sulphide may be converted into cupric sulphate by weak oxidising solutions—ferric sulphate alone, or with an addition of common salt, is either mixed with the crude mineral of the heap, or is spread over its surface, or it is dissolved, or is produced by oxidation of the ferrous liquors employed in the lixiviation.

Plausible as it may at first appear to combine the application of these several processes, results do not justify it, and, when the requirements of each method come to be examined, it will be seen that a complete realisation of the weathering process is incompatible with the introduction in any way whatever of calcination.

No matter what care be taken to provide against the spread of calcination in a heap containing any large quantity of crude ore—an isolated part of which has been ignited—it is almost impossible to prevent it. The calcination may be somewhat retarded, but in most cases it cannot be altogether extinguished. To retard it, or to attempt its suppression, recourse must be had to the use of water, and to the blocking up of all air channels, and, while under these circumstances it is hopeless to expect any beneficial result by weathering, two distinct disadvantages at once present themselves:—

1. By closing up the air passages while the heap is in any part abnormally heated, arsenious acid is produced. By the heat and slight draught, it is sublimed and carried away to cooler parts of the heap, where it condenses, the closing of the ventilating shafts forbidding its escape.

2. By the application of water to the burning pyrites, sulphuretted hydrogen is locally produced, and this, acting upon previously formed sulphate of copper, reduces it again to an insoluble state.

Even if calcined and washed ore be used in great quantities to isolate the ignited clusters of mineral, these difficulties are not surmounted, for, as we have seen, not only is the original calcination of this co-called "calcined ore" very incomplete, but there is invariably mixed with it considerable quantities of sulphide of arsenic, which, owing to the heat, suffer decomposition, and further aggregate the evil.

In the flushing of a heap of mineral thus abnormally heated, either for the purpose of subduing

the calcination or for extracting the soluble copper therefrom, the effluent liquors for precipitation are found to contain cupric and ferrous salts, and arsenious acid. The crude mineral from which the arsenic has been volatilised remains as sulphide of iron, and cannot—as when it has been freely calcined—yield ferric oxide, or soluble ferric sulphates, with which the arsenic might combine.

When liquors such as those just indicated are precipitated by pig or scrap-iron, no sooner does copper begin to deposit on the iron, than it is accompanied or followed by a deposition of metallic arsenic, most probably in the same way as in the well-known "Reinsch" test for arsenic. Here, contamination by arsenic, and that in its most malignant form, occurs immediately, so that—unlike the result in the precipitation of liquors from calcined ore—the heavy granular copper of the first tanks, as well as the fine pulvulent precipitate from the last tanks of a series, is found equally alloyed with elementary arsenic.

Systematic washing and jigging of copper precipitate containing arsenic in this form, though it increases somewhat the copper content, by removing mechanically mixed impurities, such as graphite and clay, proportionately increases also the arsenic. Washing with dilute sulphuric or hydrochloric acids, or with caustic alkali, does not sensibly improve the precipitate. Calcination, with free admission of air, is similarly ineffective, and even if the temperature be raised till fusion takes place, the molten product will be found to contain copper and arsenic in the original proportions.

But while, as I will afterwards show, the removal of elementary arsenic from copper, difficult as it is, may be accomplished, the most obvious course is, if possible, to prevent its appearance in this obnoxious form. There can be no doubt whatever that what may be called "subdued calcination," or excessive heating with insufficient ventilation, is the direct and immediate cause of it.

If, therefore, treatment by calcination be preferred, the process should be carried out in its entirety: but, if weathering and treatment by oxidising agents be preferred, a calcining temperature in any one portion of the heap—no matter how inconsiderable or how carefully isolated it may be—must be scrupulously avoided.

When, however, by the continual addition of mineral thereto, a heap assumes very large proportions, complete control over it cannot always be maintained.

Owing, it may be, to the irregular configuration of the ground upon which it stands, free ventilation throughout all its extent will sometimes be attended with much difficulty.

Excessive heating will at times takes place, apparently spontaneously, in perhaps the deepest and most inaccessible parts of the heap, and this leads to accidental calcination.

When such unfortunately occurs, immediate steps must be taken to arrest it, by cutting off the air supply and flushing the part with water.

Meanwhile the evils attendant on "subdued calcination" may be looked for in the effluent liquors, and these should be provided for by any one of the following expedients, as local circumstances may suggest:—

1st. Considerable deposits of hydrated ferric oxide may in the summer months be found in the dry beds of streams, as a result of the oxidation of waste ferrous liquors from the mine or precipitating tanks. If this material can be easily had, a filtering bed of it may be prepared, and the liquors may be passed through this before entering the precipitating tanks.

2nd. When want of sufficient level, or other local

consideration, will not allow this, soluble ferric sulphate may be added directly to the copper liquors.

3rd. When, at the same works, calcination is conducted, the liquors obtained by lixiviating the calcined ore, containing as they do a superabundance of ferric sulphates, may, when gravitation admits of it, be mixed with the arsenious liquors from the heap.

In each of these cases the aim is to convert the arsenious acid into ferric arsenite, in which form, as we have seen, it is comparatively innocuous, and may be largely and easily removed. Several years ago Mr. Down, of the Tharsis Company, proposed to filter the liquors from calcined ore through limestone or broken sea-shells to neutralise the free acid, and thus precipitate and separate the ferric arsenate before the liquors entered the cementation tanks; but since in this form the arsenic causes so little trouble, and that only in the ultimate portion of the copper precipitate, his method has not been largely adopted.

When, by misadventure, arsenious acid enters the cementation tanks with the copper liquors, it is too late to apply any of the foregoing remedies, and attention must then be directed to the easiest method of removing it from the resulting copper precipitate.

As I have said, the treatment that usually suffices for the elimination of arsenic occurring as ferric arsenite in copper precipitate, is in this case of no avail. Calcination with common salt, in the hope of subliming the arsenic as chloride, is quite futile, and, under ordinary circumstances, copper precipitate thus contaminated can only be worked up by adding to it poor sulphuretted ore for the purpose of producing "ore metal" regulus of about 35 per cent. copper.

Copper made from such regulus by the usual sequence of operations known as the Welsh method, scarcely comes up to "G.O.B." quality—that is, when the operations are conducted throughout in reverberatory furnaces. When blast furnaces are employed for the production of the "ore metal" the arsenic is sensibly diminished, but not to such an extent as to yield "best selected" copper after the usual operations for that purpose. The use of such fluxes as lime, salt, carbonate, or nitrate of soda, in the smelting, unless employed in very great excess, has but little influence.

Any process which will completely eliminate the arsenic, in whatever form it may occur, without throwing back a rich copper precipitate of perhaps 70 per cent. to 80 per cent. to regulus of 35 per cent.—which regulus in turn requires to be submitted to at least four succeeding operations before tough copper can be had—will therefore, if not too costly, be well worthy of attention. There are two processes which, to a certain degree, fulfil these conditions, the one being a wet, the other a dry method.

The wet method depends on the solubility of ter-sulphide of arsenic in solutions of alkaline polysulphide; while the dry treatment is essentially a pneumatic process similar to the Bessemer process for removing carbon and silicon from pig-iron.

In applying the wet process to copper precipitate in which arsenic occurs to any serious extent in its most virulent form, it is necessary to reduce the whole of the metallic copper to the state of cupric sulphide, otherwise the elimination of the arsenic will not be complete. For this purpose, in submitting the precipitate to the usual calcination which it receives for the purpose of drying it, and for burning off graphite, to fit it for export, it is most convenient to add to the charge a mixture of sulphate of soda and small coal in sufficient quantity to convert the greater part of the copper into sulphide. When the reduction of the sulphate of soda is sufficiently complete, the charge is immediately raked out into a

tank with a false bottom, containing a solution of polysulphide of sodium, and is allowed to remain there for two or three hours. Meanwhile the solution is made to circulate from beneath the false bottom to the surface by means of a steam blower, and at the end of the operation the liquid is in this way removed to another similar tank to be ready for a fresh charge from the furnace. A washing with water which has been previously used for the same purpose—which wash water serves in time for the preparation of a new polysulphide bath—and a final washing with clear water which may be at once run away, reduces the arsenic in most cases to mere traces. If the arsenic be present in small quantities only, the calcination with coal and sulphate may sometimes be dispensed with, but in this case the bath solution must contain a large excess of sulphur in solution. The copper precipitate is now in the state of sulphide, and what was originally an impure metallic precipitate of say 75 per cent., is after the treatment reduced to a comparatively pure sulphide precipitate of perhaps 50 per cent. Owing to its spongy nature, the sulphide precipitate may be very easily dried and calcined by waste heat from any convenient flue, the calcination beginning almost spontaneously when most of the water has been driven off, and the calcined residue consists of cupric oxide, with about 60 per cent. of copper.

The economy of this process depends on the local facilities for obtaining crude sulphur and sulphate of soda; and in some instances—where, for example, gypsum abounds in the neighbourhood—sulphate and polysulphides of calcium may be advantageously substituted for the sodium salts.

The dry method requires that the precipitate be thrown back, by addition of sulphuretted mineral, so as to form regulus of 40 to 45 per cent. copper, or even more, provided that the rejected slags formed in the production of this regulus do not contain more than 3 to 5 per cent. of copper; but the sulphur so added is utilised as fuel, and after the treatment only one operation, that of refining, is required.

The pneumatic treatment of copper ores and regulus for the production of metallic copper, was proposed more than 30 years ago, anterior in point of time to the advent of the Bessemer process for iron, and at intervals since then it has been resuscitated by various experimenters. The chief difficulties encountered have been in finding a suitable lining material for the vessel in which the operation is conducted, and in providing against the oxidation by the blast of the reduced metallic copper as it forms. The formation of a slag of silicate of copper, by combination of copper so oxidised with the siliceous lining of the vessel, has suggested to some the arrestment of the process at the stage of "blue metal," or "white metal," and the consequent evasion of this difficulty. Two French metallurgists, MM. Manhès and David, have, however, succeeded in overcoming the difficulty without thus interrupting the process; and by employing their converting vessel, 98 per cent. copper, practically free from all objectionable impurities, and containing only small quantities of iron and sulphur, can in a few hours be obtained from copper precipitate containing as much as five per cent. of arsenic in its most objectionable form.

The converting vessel employed by these gentlemen is of the form of a horizontal cylinder, which can be made to rotate on its axis by means of a rack and pinion. The air blast enters the vessel in the direction of a tangent to the interior superficies, and by rotating the vessel the blast may be made to penetrate the molten regulus, at any angle, or to any desired depth. It may thus be injected through a

superficial layer of molten sulphide, without touching any accumulation of metallic copper underneath it.

The lining difficulty is met by making the lining as siliceous as possible, regarding it as the most convenient means of supplying silica to the oxidised iron, and making provision for its frequent renewal.

Under this treatment arsenic, antimony, and other such impurities, are, for the most part, oxidised and volatilised.

I do not know that this process is in use at any of the works where the impure precipitate is produced, but such precipitate is satisfactorily treated by it at Continental works to which the precipitate is sent. The process is at work in France, Germany, and the United States, and I believe the only works at which it has been adopted in this country are those of Messrs. Vivian & Sons, Hafod, Swansea. As an instance of how prejudices may be overcome, this latter fact forms a strange commentary on the opinion expressed by Sir Henry, then Mr. Hussey-Vivian, when in 1879 the Hollway process was under discussion before the Society of Arts, to the effect that "the Bessemer process was quite inapplicable to copper smelting."

I cannot conclude without adverting to the method of refining employed by Elliott's Metal Company, at Selly Oak, near Birmingham, in this country, and at several Continental and American works, where anodes of coarse copper are dissolved and deposited electrolytically in the purest possible state. Arsenical copper precipitate might be melted and cast into suitable anodes for this process, but as the resulting copper is unnecessarily fine for all but electrical purposes, the cost of the treatment, where neither silver nor gold would be recoverable as by-products, would scarcely permit of its general adoption.

The occurrence of arsenic in copper liquors obtained by the Henderson process in this country, and its removal from these, has been frequently discussed, but I am of opinion that in these discussions the all-important question as to the condition in which the arsenic exists in the respective liquors experimented upon has been entirely overlooked.

According to Lunge ("Sulphuric Acid and Alkali," vol. i. p. 621), Bischof found that when spongy iron was used for the cementation, arsenic was precipitated only after the copper had been precipitated; while Gibb, on the other hand, affirms that he never found any trace of arsenic in solution after the copper had been precipitated, whichever form of iron or solution of copper might be employed.

These statements, contradictory as they appear, are perfectly reconcilable one with the other, on the assumption that in the first case the arsenic was present as ferric arsenite, maintained in solution by free acid, and that in the second case it appeared in the liquors as arsenious acid.

DISCUSSION.

DR. WALLACE said that the author had not referred to the separation of arsenic as carried on in Glasgow and elsewhere in this country. His impression was that at the works in Glasgow the arsenic was precipitated by "bog liquor," or the drainage of the waste heaps of St. Rollox, which contained a large proportion of sulphide and polysulphides of calcium. This not being available in Spain, he would like to know what means they adopted there. He thought that the Spanish method of calcination prevented recovery of the gold and silver present in the ore; and it was only in this country, where the pyrites was first burned for its sulphur, and then calcined with common salt, that the precious metals were recovered. Perhaps the author would enlighten them on this point.

Mr. PATTISON asked if any objection was raised in the localities where these processes were carried on to the noxious fumes evolved?

The CHAIRMAN apologised for the lack of discussion, as the subject was so unfamiliar to the majority present. At the same time they all felt great interest in the question.

Mr. FULTON, in reply, said: Dr. Wallace has remarked that no reference has been made in this paper to methods of removing arsenic from copper liquors, as employed in works in this country, and he spoke of some method of precipitating the arsenic by means of liquors draining from heaps of alkali waste. I would remind him that at the outset I professed to deal only with the local treatment at the mines, which of itself is a sufficiently comprehensive subject. I do not see in what way the alkali waste solution could be employed for the precipitation and separation of arsenic from copper solutions, since, by employing it, both copper and arsenic would be precipitated together. In treatment by the Henderson process, I believe that arsenic principally occurs in the tower liquors, along with the hydrochloric acid; and the final washings of the mineral with these liquors are generally kept apart from the purer solutions obtained from the earlier lixiviations. Several years ago, Messrs. Gibb & Gelstharp, of the Bede Metal Works, Jarrow-on-Tyne, obtained a patent for the precipitation of arsenical copper from these tower liquors, prior to their use in the final lixiviations. They probably found that these metals could be precipitated by iron, before the free acid became saturated, and the acid liquors thus purified were suitable for the removal of the last traces of copper from the mineral, without contaminating it with arsenic. As for the recovery of gold and silver from the mineral submitted to local treatment by calcination, the solutions formed are, for the most part, sulphate solutions, and the noble metals are, under these circumstances, left in the washed, calcined ore. Attempts have been made to remove these, after the copper has been washed out, by treating the residues with brine. A further quantity of copper is thus obtained, and the whole may be precipitated by iron, as argentiferous copper, containing a little gold. As a matter of fact, however, treatment in this way has not hitherto been remunerative. In reply to Mr. Pattison's inquiry as to the damage occasioned by the sulphur smoke, and the attitude of the public towards this, I may say that before extensive operations, involving calcination, can be commenced, it is necessary to acquire large tracts of country around the site; but this does not prevent much damage being falsely ascribed to the influence of the smoke, in lands which have not been so acquired, and extravagant claims for compensation are being continually made.

Nottingham Section.

Chairman: Professor Frank Clowes.

Vice-Chairman: Lewis T. Wright.

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J. F. Warwick.
R. L. Whiteley.

Hon. Local Secretary:

J. R. Ashwell, Midanbury Lodge, Bentinck Road,
Nottingham.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held March 6, 1886, in the Mechanics' Institute, Nottingham.

ADDENDUM ON THE USE OF ANTIMONY MORDANTS IN HOSIERY DYEING.

BY HENRY FORTH.

THE use of tannate of antimony is, when compared with the tannates of tin, of recent introduction as a mordant. Its use, when prepared from solutions of tartar emetic and tannin, for fixing aniline colours, appears to have been discovered in 1861, by Dale, though it was but little used till long after that. Upon hosiery it does not seem to have been used till about five or six years ago, for my friend Mr. J. R. Ashwell tells me the first time he met with tannate of antimony upon dyed hosiery was in the year 1879. Since this date, antimony, either as tartar emetic, and more recently as the double oxalate of antimony and potash, or as the fluoride, has been increasingly and largely used for the production of tannate of antimony as a mordant upon hosiery.

The great recommendations for the use of tannate of antimony are—(1) It is a cheaper mordant than tannate of tin; (2) it produces faster or more insoluble compounds with "aniline" colours than tannate of tin; (3) goods so mordanted are very soft. Various statements, most of them very intangible, have been made respecting the poisonous properties of tannate of antimony as a mordant—e.g., R. Kaysner, *J. Soc. Chem. Ind.* August, 1883, says: "When tartar emetic and tannin are used as mordants, a very small quantity of antimony is always found in the finished cloth, if the work has been carefully executed. But when the operation has not been properly conducted, very large quantities of antimony compounds may remain. As an example, a piece of brown cloth was found to contain per sq. dem. 0.085grm. of antimony. This cloth worn next the skin produced troublesome sores, which however disappeared quickly on the removal of the objectionable cloth. It appears that the "cloth" containing 0.085grm. Sb per sq. dem., was cloth used for trouser pockets, and not hosiery worn next the skin.

Experiments have been made to obtain a very large amount of antimony fixed upon hosiery as the tannate. I employed what for hosiery is a very excessive quantity of tannin—viz., ten per cent. of tannic acid needles—and then, after steeping all night, a bath of tartar emetic at 20grms. per litre. Hosiery thus mordanted was then dyed with a common magenta containing a trace of arsenic, and all operations of rinsing with water and soaping (which are customary) were omitted; the hosiery being simply dried out of the dye liquor. This method ensured as much antimony being left upon the hosiery as was possible. On analysis it was found to contain 1.1682 per cent. of Sb, and one sq. dem. only contained 0.02145grm. Sb, or practically one-fourth of the Sb which was upon the sq. dem. of Kaysner's cloth. If, however, the weight of the hosiery fabric per sq. dem. was doubled, a fabric would be obtained of such weight that rarely, if ever, finds its way into the market as hose.

To carry this further, this dyed fabric containing 0.02145grm. Sb per sq. dem. I wore upon my feet for twenty-two consecutive days, and found no irritation proceed therefrom.

This case is throughout excessive as regards the quantity of antimony upon the hose, and every care was taken to so manipulate the dyeing and mordanting that the antimony compounds might

remain upon the hose, if not in a soluble form, at least loosely, adhering mechanically.

The use of antimony—through, I suppose, its novelty—has met with decided opposition in some quarters. Certain dyers are told that tartar emetic being poisonous and skin irritating, therefore they must undertake *not* to use it in dyeing their goods. These manufacturers either forget or do not know that whilst tartar emetic is easily soluble, the tannate of antimony which is present upon their goods is insoluble. Many hosiery dyers are thus prevented from using a mordant which they know to be much better than tin for fast and bright cheap colours.

A most successful dyer tells me that he always soaps his cotton goods *after* mordanting with tannate of antimony, and *before* dyeing. Thereby he removes any loosely-adhering particles completely, and renders the mordant quite insoluble. The fastness and brightness of the resulting colours more than repays for the extra expense.

So much better does he find an antimony mordant than a tin one, that, excepting where restrictions are forced, he has entirely adopted it, and has had no complaints of the dyed goods acting in a poisonous or irritating manner upon the skin.

Other dyers give me similar information.

This mordant, therefore, I submit, after the ordinary severe rinsing and soaping combined with friction always given in hosiery dyeing, has no poisonous or irritating action on the skin.

Tannate of antimony is used as a mordant in precisely the same way as the tannates of tin are. The method employed is similar, a solution of an antimony salt being substituted for a solution of a tin salt, and the goods saturated with tannin solution, are steeped in the antimonial solution, etc., as we have heard described as customary when the salts are employed.

DISCUSSION.

The CHAIRMAN alluded to the double aspect—both chemical and medical—of the papers by Mr. J. H. Ashwell and Mr. Henry Forth, and invited discussion both from members and visitors.

Dr. HANDFORD agreed with a great deal that the papers had stated with regard to the non-irritating character of nearly all colours upon dyed hosiery. He could not recollect a single instance where he had been satisfied that the dyeing matter had been a definite cause of irritation. But there were such cases on record; though in five or six years' experience at a large hospital he could not recollect a single one. It was well known that the entrance of small quantities of antimony or lead into the system over a lengthened period had a bad effect, but did not necessarily produce any local irritation. In his opinion, undue importance had been given to the insolubility of these bodies in cold water. During wear they were moistened with perspiration and subjected to friction, and it was therefore necessary to ascertain whether they were insoluble in a slightly acid solution—such as lactic acid. But even if they were insoluble under these conditions, traces of them might still find their way into the pores by means of friction, and so gradually pass into the lymphatics. In the *Lancet* of February 27, a letter appeared describing a case of severe irritation of the skin arising from wearing a pair of scarlet socks. The material was not mentioned, but was probably silk or cotton. The socks were analysed, and two decigrammes of arsenic were obtained. Now it was more especially arsenic which would produce skin irritation, and many cases of eruption had occurred in the town from handling paints containing it. Chromium had much the same effect. He might add that

aniline dyes were much used in colouring microscopic preparations, but were so extremely soluble in water that they were easily washed off.

Mr. WHITELEY thought that the question which ought to be decided was whether, in the likely event of antimony or arsenic coming in contact with the skin, they would produce irritation. He thought not. Here was an isolated complaint made against one pair of socks out of a large number prepared at the same time and in the same way. How was it that there were not cases wherever the socks had been worn? It was more probable that the constitution of the wearer was really in fault. Tartar emetic was a skin irritant, but were all other antimony compounds, such as the tannate, irritants as well, any more than tannate of tin or iron, against which no complaint was laid?

Mr. COLEMAN suggested that alkali might dissolve antimony and arsenic; and perspiration which contained alkali might cause absorption under friction.

Dr. APLEY STEPHENSON confirmed the remarks of Dr. Handford. He had never met with any cases attributable to irritants in hosiery. On the other hand, he facetiously remarked that distinct benefit accrued from the slight colouration caused by the dyes coming off the hosiery, for it induced more frequent washing, and hence greater cleanliness. The effect of tartar emetic was general rather than local; and as to dyes as a whole, he had not found them specially unwholesome to those engaged either in their manufacture or their application. Skin diseases arose more from lack of personal cleanliness or ordinary precautions than from any other cause.

Mr. GOODALL, speaking for the hosiery trade, welcomed the discussion, and said that they were desirous of challenging chemical tests of every kind. Hosiers ought to be prepared to state that their dyes and ingredients were neither irritants nor poisonous, but just now they had to face a wave of suspicion. One most difficult case that had lately arisen was that of a gentleman who had worn a sock made of cotton and silk, the silk part of which was dyed with picric acid. Would picric acid produce skin irritation? In New York there had been much discussion about a certain "bright cardinal" imported from Germany, and said to contain arsenic, and the local medical officer of health had taken up the question.

Mr. PENTECOST asked whether there were any cases of silk goods having proved irritating to the skin; and whether, when irritation had been alleged, the goods were all wool, all cotton, or a mixture. If they were cotton then tartar emetic might be accused; if silk, arsenic might have been the cause.

Dr. HANDFORD, in answer to the question that skin irritation attributed to dyed hosiery might in reality be due to the general health of the wearer, said that where they found that the wearer had no previous irritation, and that his complaint was not only local to the parts in contact with the hosiery, but also disappeared when the garment was left off, one could hardly fail to attribute the irritation to the wearing of these coloured goods. As to the power of the skin to absorb insoluble bodies, there was the well-known instance of salivation caused by anointing the skin with mercurial ointment.

Mr. FORTH, in reply, stated that his remarks upon antimony were founded upon personal observation, by wearing socks for a length of time charged with as much antimony as they would hold.

Mr. J. R. ASHWELL, in reply, said that he fully recognised the difficulty as to perspiration, and was engaged in making some experiments which would throw light upon the matter. The New York case had been referred to, but the examination of a medical officer, as detailed in the papers on the sub-

ject, had elicited that he knew nothing whatever of the proper tests for antimony or arsenic. When asked how he could detect these bodies, he replied, in effect, "Very simply; take the red fabric and treat it with dilute acid, and if these bodies be present it immediately turns blue." At some future date he hoped to reopen the question, and to speak about some mordants the action of which upon the skin, if not injurious, was at least to be avoided.

Meeting held April 9, 1886.

ON SOME POINTS IN THE ANALYSIS OF OILS.

BY LEONARD ARCHBUTT, F.C.S.

DURING the course of the last four or five years a good deal of my time has been engaged in the examination of oils, especially olive and rape oils. A considerable amount of information has thus been gained, and experiments have had to be made, some of the results of which are embodied in the following paper:—

Maumené's Temperature Reaction.—Some years ago, M. Maumené proposed a very simple and expeditious method of testing oils, based on the rise of temperature which takes place when the oil is mixed with concentrated sulphuric acid. His plan of operating is to weigh 50grms. of the oil into a beaker, and place in it a thermometer; the temperature of the oil having been recorded, it is stirred with the thermometer while 10cc. of strong sulphuric acid are added from a pipette, and when the mercury ceases to rise, the temperature is again recorded. The difference between the two numbers thus obtained is the "rise of temperature" for the particular oil; and seeing that this ranges from about 40° C. for olive oil up to about 135° C. for linseed oil, it is evident that we possess in this very simple process a most valuable method of testing oils, provided of course that the results obtained are constant for each kind of oil. The figures published by Maumené were subsequently confirmed by Fehling, Faisst and Knauss, and by Allen, and the figures obtained by all these observers are to be found in a paper by Mr. Allen, published in the *Analyst* for 1881, p. 102, where the method is fully discussed.

In the *Comptes Rendus* for 1881, Maumené published some further notes on the test, wherein he stated that sulphuric acid which had been recently heated, "without having lost the least trace of water," liberated far more heat with linseed oil than the original acid. Allen, however, on repeating these experiments, failed to verify this statement, and my own observations confirm those of Allen. In explanation of Maumené's results, Allen suggested that the acid used must have been a weak one to commence with, and that it really did lose water on heating; but the increase of strength must have been very considerable to account for the very great differences in Maumené's figures.

It was just about this time that I began to use the test very frequently in examining samples of rape and olive oil, and I soon found that without great care very discordant results might easily be obtained, and that even with the greatest care, and the adoption of every precaution to ensure uniformity in the mode of operating, the figures yielded by the same sample of oil are liable to obscure variation.

Thus, at the outset, I made the two following experiments:—

(1.) SHOWING THE RESULT OF USING ACID NOT CAREFULLY PRESERVED.

"Concentrated" Sulphuric Acid. Rise of Temperature.

a. From Laboratory Reagent Bottle	32½° C.	} With the same sample of oil.
b. From a "Winchester"	76°	
c. From same "Winchester," recently heated	76°	

(2.) SHOWING THE INFLUENCE OF STIRRING.

Rise of Temperature.

a. Oil and acid stirred until all the acid had been added; then, the thermometer held stationary in the middle of the oil	75° C.	} With the same sample of oil.
b. Stirring kept up until the temperature ceased to rise	73½°	

The plan of working which I then adopted, and still employ, is as follows:—I use *sulphuric acid* of definite strength preserved in a capped ether bottle; a 10cc. pipette, accurately graduated and kept specially for this test; beakers, No 3, 7oz. capacity, of tall form, which fit into a "nest" of cardboard, having hollow sides stuffed with cotton wool; a centigrade thermometer, 50grms. of the oil to be tested are weighed into one of the beakers, to within 10 or 20 milligrammes. The bottle of acid and the beaker of oil are placed in a vessel of water until both have acquired the temperature of the water, the thermometer having been placed in the oil. The beaker is then removed from the water, wiped outside, and placed in the nest. The temperature having been verified and recorded, 10cc. of acid are rapidly withdrawn from the bottle, which is immediately closed again, the acid is allowed to flow into the oil while it is being stirred with the thermometer, and the stirring is continued until no further rise of temperature is observed. The stirring must be so managed as to effect as perfect an admixture of the oil and acid as possible, thereby ensuring an even development of heat throughout the mixture. It is highly advisable to keep at hand a stock of oil of known purity, and to test some of this side by side with every batch of oils examined.

Some observers lay stress on the importance of having the oil and acid at some *constant initial temperature*. I believe this to be unnecessary. Thus, the examination of a large number of samples of olive oil have given the following results:—

Initial Temperature.	Limits for Genuine Olive Oil.	
19°—20° C.	39½°—44½° C.	} Rise of Temperature.
10—12	38½—45½	
7—8	40—42½	

The vessel of water used to equalise the temperature of the acid and the oil may therefore be conveniently maintained at the temperature of the laboratory for the time being.

So far, I have said nothing as to the strength of the acid employed. Though it is perfectly well known that the heat developed depends to a large extent on the strength of the acid used, no experiments have hitherto been published showing what this variation actually is. The direction is generally given to use acid of some fixed specific gravity, but it has been shown by Lunge and Naef that the sp. gr. of sulphuric acid above a certain strength undergoes very little variation, and moreover above 98 per cent. it decreases. Some experiments of my own which were made before the publication of Lunge and Naef's figures, confirm their results. Nine specimens of acid were prepared, calculated to differ from each other by 1 per cent of real H₂SO₄, and each of these was very carefully analysed by titration with a standard solution of sodium carbonate,

methyl orange being used as indicator. About 3grms. of the acid were taken for each experiment. The standard alkali used was set by means of a specially prepared normal hydrochloric acid, the sp. gr. of which was ascertained, and which was analysed by precipitating weighed quantities with silver nitrate. The volumes of acid and alkali employed throughout were weighed, so as to avoid errors in measuring, the alkali being added in very slight excess, and the solution then adjusted to neutral point by running in deci-normal hydrochloric acid.

The following experiments, made with these acids on three typical samples of oil, show the influence of the strength of the acid on the heat developed:—

Percentage by weight of real H_2SO_4 .	RISE OF TEMPERATURE OBSERVED (° C.).		
	Genuine Olive Oil	Genuine Rape Oil	Impure Olive Oil.
97.38	43½, 42½	63, 62	48½, 48½
96.71	42	61	47, 47½
95.72	39	58	43½, 44½
94.72	36½	54	40½, 40½
93.75	34½	50½	38½, 39
92.73	31	47	35½, 35½
91.85	28, 29½	40½, 43	32½, 32½

With 94.72 per cent. acid the rise of temperature was slow. With 93.72 per cent. acid it was very slow, and with weaker acid it was very much slower. The results show that there is no advantage in using the weaker acids on the ground of greater concordance in the results, so that I prefer to use an acid of 97 per cent. strength. The sp. gr. of this acid, and of those employed in the above experiments, was taken by Sprengel tube, with every precaution, at 60° F., as compared with freshly boiled distilled water at 60° F. The results are as follows:—

Percentage by weight of real H_2SO_4 .	Specific Gravity at 60° F. (Water at 60° F.=1.0000).	Difference.
97.38	1.8411	—
97.02	1.8440	.0001
96.71	1.8438	.0002
95.72	1.8427	.0011
94.72	1.8406	.0021
93.75	1.8378	.0028
92.73	1.8341	.0034
91.85	1.8309	.0035
90.73	1.8255	.0051
(89.73)	1.8201	.0051

Soon after I had made these experiments, I obtained an interesting confirmation of the results. A friend of mine wrote me to the effect that he was getting very much less rise of temperature with olive oil than the figures published by Maumené. I suggested to him that his acid was weak, and asked him to send me some of it, and also some of the oil he was testing. I then tested his oils with my acid and with his acid, and I took the specific gravity of his acid. The results are given in Table A.

The acid which my friend had used had been supplied to him as concentrated sulphuric acid, and this led me to test several Winchesters of acid from my own stock. The results showed that the "pure con-

centrated sulphuric acid" (free from lead), as ordinarily supplied in Winchesters by the dealers, is liable to considerable variation in strength. Thus, I found the acid in eight unopened Winchesters varied as follows:—

H_2SO_4 per cent.	
1.....	97
2.....	97
3.....	95.3
4.....	92.7
5.....	97.4
6.....	97.4
7.....	95.9
8.....	96.8

} Analysed directly.

} Calculated from specific gravity.

Adopting all the precautions which I have described, Maumené's test leaves much to be desired. The indications yielded by it, taken in conjunction with other tests, are of very great value; nevertheless, they sometimes vary in a most unaccountable way. The results to be found in Allen's "Commercial Organic Analysis" serve sufficiently to show what each kind of oil may be expected to give; but every observer should construct a table for himself, and whenever a sample of oil is tested, a comparative experiment with one of the same kind, and of known purity, ought to be simultaneously made.

The following additional experiments were made in endeavouring to find the proper rate at which to add the acid. A genuine rape oil was used:—

	Rise of Temperature (° C.)
A. By the method already described, the acid being allowed to flow from the pipette as fast as it would deliver.....	61, 61.
B. Same as "A," but the acid was allowed only to drop slowly from the pipette.....	61, 61, 61, 61, 63, 63, 62.
C. Same as "A," the acid being allowed to drop rather fast.....	63, 60½.

From these experiments, it appears best to allow the acid to drop slowly into the oil; but I think it is very probable that more concordant results would be obtained if some better method of mixing the oil and acid were to be adopted than is possible by simple stirring with the thermometer. No satisfactory plan of effecting this has at present occurred to my mind.

The Elaidin Test.—The fact that olive and other non-drying oils possess the property of becoming converted into solid isomeric modifications under the influence of nitrous acid was first applied to the detection of adulteration in olive oil by Pontet, in 1819.

Pontet's reagent was prepared by dissolving, at the ordinary temperature, 6 parts by weight of mercury in 7½ parts by weight of nitric acid of 38° Beaumé (sp. gr. 1.35). The solution so formed was shaken with the oil to be tested, in the proportion of 1 part by weight of the reagent to 12 parts by weight of the oil, and the agitation repeated every ten minutes during two hours. The bottle containing the now possibly solid mass was placed in a cool cellar for twenty-four hours, at the end of which time the consistence of the product was noted. If the oil were genuine, a hard mass was the result; if mixed with oils of a drying character (especially poppy oil), the contents of the bottle were fluid, or imperfectly solid. By this means, 10 per cent. of poppy oil could be detected, but with a smaller proportion the results were uncertain.

I am not aware that a systematic study of this reaction of Pontet's, showing how far it is really applicable to the detection of adulteration, and the best mode of applying the test, has ever been made. Subsequent observers appear to have considered Pontet's reagent too troublesome to prepare, or uncertain in its indications, and have proposed others; but little real advance in the application of the test appears to have been made since the time of Pontet.

Boudet, in 1832, found that the active principle of Poutet's reagent was free nitrous acid, and he proposed to employ the latter mixed with three times its weight of nitric acid, of 1.31 sp. gr., as a substitute. Boudet found that $\frac{1}{10}$ th part of nitrous acid is sufficient to cause the solidification of olive oil. Less than this was without effect.

Fauré made some experiments with Boudet's reagent on mixtures of olive oil with poppy and walnut

At 8° C.—

Fermented oil + 5 Sesame.—Formed a solid but soft mass.
 „ + 5 Cotton.—Formed a mass of consistence of tallow.
 „ + 5 Arachis.—Gave a solid mass, softer than fermented oil alone.

Roth's experiments are the only ones with which I am acquainted in which the temperature is recorded, other observers having contented themselves with

TABLE A.

	I OBTAINED WITH		B.'s Figures.
	My Acid,	B.'s Acid,	
	Sp. Gr. 1.6440	Sp. Gr. 1.6352.	
1. Olive Oil	39° C.	29° C.	29½° C.
2. Sublime Olive Oil.....	40½	30½	31
3. Finest Sublime Olive Oil	40½	30½	31½

oils. 100grms. of oil were mixed with 3grms. of the reagent, and the time required for solidification was observed. The temperature, a most important point, does not appear to have been recorded.

Percentage of Adulterant.	Number of Minutes required for Solidification.	
	Poppy Oil.	Walnut Oil
0	55	55
5	90	85
10	115	108
20	215	117
30	680	310
50	1597	435

Barbot, in 1841, proposed the use of nitric acid saturated with nitric oxide, but the experiments which he recorded show that his reagent is decidedly less useful than Poutet's.

Kopp adopted the very simple plan of adding to 9 volumes of the oil 1 volume of nitric acid, of 1.3 to 1.4 sp. gr., and dropping into the nitric acid (which forms a layer at the bottom of the vessel) some copper turnings. When the evolution of gas had proceeded a short time, the whole was stirred up and set aside. The indications obtained in this rough manner must be very uncertain and unreliable.

Lastly, Jules Roth used sulphuric acid, containing 56 per cent. of H_2SO_4 , saturated with nitric and nitrous acids. The reagent was prepared by acting on iron, in large lumps, with nitric acid, the nitrous gas evolved being passed at a moderate rate into sulphuric acid of 46° Beaumé, which at the end of six to eight days (!) became saturated with the gas, and assumed a deep bluish-green colour. 9grms. of oil were mixed with 7grms. of the reagent by stirring with a glass rod, and the mixture then left to itself. Some of Roth's results are given in Table B on next page.

Mixtures :—

At 5° C.—

Fermented oil + 10 Sesame.—Assumed consistence of honey.
 „ + 10 Cotton.—Remained semi-fluid, but more solid than the sesame mixture.
 „ + 10 Arachis.—Became more solid than the cotton mixture.

making the test “in a cool place.” He appears to have adopted a very tedious method of preparing his reagent, and the results of his experiments on mixtures do not at all agree with my experience.

I have not actually tried Roth's plan, but I have made a somewhat similar reagent by passing dry SO_2 (from one of Boake's siphons) into cold nitric acid of 1.42 sp. gr. In about ten minutes a liquid was produced which solidified olive oil in from twenty to thirty minutes at 10° C., a white product being formed, similar to that described by Roth. But the same reagent solidified cotton oil in forty minutes, and a mixture of olive with 10 per cent. of cotton oil in twenty-five minutes, with formation of a white mass resembling that produced by olive oil alone; so that, as a test for cotton oil in olive oil, the reagent proved to be useless. The product yielded by pure cotton oil was red, and that given by rape oil deep red; but 10 per cent. of either of these oils in olive oil did not sensibly colour the elaidin.

Some further remarks on this reagent may be of interest. At a temperature of 10° C. nitric acid of 1.42 sp. gr. rapidly absorbs dry SO_2 gas, assuming at first a red, and ultimately a brown-green colour. On continuing to pass the gas, a very deep green liquid separates out, which rises to the surface and continues to increase in bulk; and then a white crystalline body forms in the liquid below, which ultimately chokes the tube. The deep green liquid is free from every trace of sulphuric acid, and consists wholly of nitrous acid, with some nitric acid. The white crystalline body is, I suppose, nitro-sulphonic acid. By stopping the passage of the gas as soon as the deep green liquid begins to form, a solution is obtained containing sulphuric, nitric, and nitrous acids, with which the following experiments were made :—

Quantities, of 100cc. each, of the same sample of olive oil were taken, and severally mixed with the following proportions of the reagent. The mixtures were placed in water at 10° C., and shaken at intervals of ten minutes until solidification took place, the test of solidification being that the mass did not move on moderately vigorous shaking.

No. of cc. reagent used.	Minutes required for solidification.
1cc.	120
1½	55
2	35
2½	35
3	35
3½	30
4	35
10	40

Boudet showed that less than '05 per cent. of nitrous acid failed to cause the formation of elaidin. The above experiments show that the increase of the proportion beyond a certain amount no longer hastens the change. In fact, when too much of the reagent is used, a portion simply falls to the bottom of the vessel after shaking, and is removed from the sphere of action: besides which, heat is developed during the shaking, and the experiment may become dangerous. Moreover, too large a proportion of nitrous acid is disadvantageous, because, as I have already mentioned, the adulterating oils themselves become solidified, and the value of the test is spoiled.

1.42 sp. gr., a reagent can be obtained which gives perfectly constant results, and which will keep for at any rate several days. I will describe exactly the way in which I proceed.

I have made out of a piece of barometer tubing a small measure which holds exactly 6grms. of mercury. Three "measures" of mercury are placed in a dry stoppered 50cc. cylinder, and 15.6cc. of nitric acid of 1.42 sp. gr. are added from a burette. Action at once commences, but there is no escape of gas, the nitrous acid being entirely absorbed, with production of a deep green colouration, which slowly rises and spreads throughout the nitric acid. After a short

TABLE B.

	5° C.	8° C.	Summer Temperature.	24° C.
Virgin olive oil.....	Solid in 20–30 mins.	—	Solid in 60–90 mins.	Solid in 420 minutes.
Fermented oil— <i>i.e.</i> , expressed from olives which have fermented	Solidifies more slowly than virgin oil—often only at the end of some hours in summer. The product is softer, and not white, like that yielded by virgin oil, but greenish-yellow.			
Arachis oil	Solid in 75 minutes.	—	Remaining fluid for some days.	—
Oleic acid.....	Behaves like arachis oil.			
Colza oil	Deep red mass, of consistence of pomade, after some time.	—	Does not solidify.	—
Sesame oil	Does not solidify, but assumes the consistence of honey in winter.			
Cotton oil.....	—	After some time, assumes consistence of tallow.	—	—

TABLE C.

MINUTES REQUIRED FOR SOLIDIFICATION.

TEMP (° C.)	0°	5°	10°	15°	20°	25°	30°
Series 1..	50	60	60	80	120	—	—
.. 2..	60	60	60	75	150	—	—
.. 3..	—	—	60	—	—	—	—
.. 4..	—	—	60	—	—	200	—
.. 5..	—	—	60	—	—	—	(Not solid in eight hours; but at end of twenty-four hours was a solid yellow, tolerably firm mass, with a little yellow oil on the surface.
.. 6..	—	—	—	—	—	230	
.. 7..	—	—	—	—	—	210	—

I now return to the consideration of Poutet's reagent. As originally described, nitric acid of 1.35 sp. gr. was directed to be used, and the proportion of mercury employed was so adjusted as to practically saturate the acid in the cold. The solution thus prepared has a blue-green colour, and very rapidly undergoes change. Hence, it had to be always freshly prepared, which was certainly an inconvenience. I have only made two experiments on olive oil, following Poutet's instructions exactly, and in one case the sample solidified in 175 minutes, while in the other experiment only 100 minutes were required. The temperature was in each case 10° C., and the same oil was used; but the reagent was freshly prepared for each experiment.

I have found, however, that by employing acid of

time, the cylinder is placed in water at 10° C., the stopper being tightly screwed in to prevent the escape of any red fumes which may be evolved. In from five to ten minutes the mercury has entirely disappeared, and a deep green liquid remains, with some white solid at the bottom. The stopper is cautiously removed, and the white deposit, if considerable, is dissolved up by careful stirring and, if necessary, very gentle warming. .96grms. of the oil to be tested are next weighed into a wide-mouthed stoppered bottle, and 3.25cc. (or 8grms.) of the deep green reagent are added from a burette. The whole is then shaken up, placed in water at the required temperature, and again shaken at intervals of ten minutes until solidification takes place, or until further shaking is considered unnecessary.

I have thus described the method in detail, because I think an empirical test of this nature ought to be so described; but very likely it is not necessary to adhere rigidly to all the proportions given. I may, however, here remark, that when working at low temperatures, I have found shaking at more frequent intervals than ten minutes give less concordant results.

The series of experiments given in Table C were made exactly as above described, in order to ascertain—(1) whether the results were concordant, and (2) the influence of temperature. The same sample of olive oil of superior quality was used throughout, and each series of experiments was made on a different day, with a fresh reagent.

After the solidified mass had remained at the temperature of the experiment for about twenty-four hours from the time of starting, the hardness of the elaidin was tried by forcing down upon it a stout glass rod, $\frac{3}{8}$ inch diam. In this way it was noted that, with the particular oil here used, the elaidin formed at—

0° C. was pale yellow and impenetrable;
10° C. " " " " " "
20° C. " " " " " " barely penetrable;
25° C. " lemon " " " only just "
30° C. " " " " " " easily " but fairly firm.

The colour of the product deepens as the temperature is raised, and the hardness diminishes.

These experiments show the importance of working at some uniform temperature, and they also establish the concordance of the results, more especially at low temperatures. The solidification at a lower tempera-

est were performed on a large or a small quantity of oil, and in order to settle this I made three mixtures, viz. :—

- 1.—96grms. of oil + 8grms. of reagent.
- 2.—48 " " + 4 " " "
- 3.—12 " " + 1 " " "

The first two experiments were made in stoppered bottles of different sizes, the last in a corked specimen tube. The temperature was 10° C., and each mixture solidified in 60 minutes.

The results being so far satisfactory, I wished to ascertain whether the reagent required to be freshly prepared. My impression was that so long as it maintained its *deep green* colour it would be fit for use. To prove this, I made up enough to fill a 50cc. cylinder. Two olive oils were then tested with the freshly made reagent, and the cylinder was stoppered and placed aside in a cool and dark corner of the laboratory for future experiments. This reagent has given the following results :—

Reagent.	Minutes required for Solidification.	
Temperature 10° C.	Olive Oil A.	Olive Oil B.
Freshly prepared	50	60
1 day old	—	70
7 days old	—	65
10 days old	60	—
14 days old	50	65
21 days old	60	—
39 days old	60	—

Thus, so long as the reagent is carefully preserved and retains its deep green colour, it is fit for use.

In Table D I give the results of experiments made at 10° C., on different varieties of oil, and in the manner already described.

TABLE D.

NAME OF OIL.	Minutes required for Solidification at 10° C.	After 24 hours at 10° C. from time of starting.	
		Colour.	Consistence.
Olive Oil (superior)	60	canary yellow	Impenetrable with stout glass rod
Oleic Acid (commercial)	50	{ first blood-red, ultimately lemon-yellow }	Easily penetrable
" Best Nut Oil "	60–90	pale lemon	Soft
Neatsfoot Oil	180	lemon	Barely penetrable
Refined Rape Oil	more than six hours	deep orange	Apparently solid *
Bottle-nose Whale Oil	160	deep lemon	Soft
Sperm Oil (old sample)	(not solid, but very thick in 6 hours)	orange	Buttery
" Ground Nut Oil "	—	orange	Mainly fluid
Cotton Oil	—	orange	Thin turbid fluid
Refined Niger Oil	—	orange	Thin fluid
Cod-liver Oil	—	blood-red	Fluid, with good deal of sediment
Castor Oil (cold drawn)	—	lemon	Much same as original oil
Sesame Oil	—	orange	Very thick fluid
Strained Menhaden Oil	—	dark red	Turbid fluid

* Rape oil gave an apparently solid mass at the end of 24 hours at 10° C., but on standing the bottle in water at 15° C. the whole became fluid. Moreover the stability of the mass at 10° C., if tried with a glass rod, was destroyed, and it became converted into a thick cream.

ture takes place suddenly, whereas at the higher temperatures it is more gradual; and this explains why the results at higher temperatures are less concordant, it being more difficult to estimate the time accurately. It became next of interest to ascertain whether the concordance would hold whether the

It now remains to consider the best mode of applying the test, so as to detect fraudulent admixtures, and though I have made a considerable number of experiments to investigate this point, they are scarcely at present in a sufficiently complete state to record in detail.

The results so far obtained, however, point to the following conclusions:—

- (1) That the test must be made at a temperature not lower than 25° C., and that the temperature must be uniform throughout the experiment.
- (2) That the length of time required for solidification is of far greater importance than the ultimate consistence of the elaidin formed.

Experiments made on genuine olive oils at 25° C. have given the following results:—

	Number of Minutes required for Solidification.		
	Expt. 1.	Expt. 2.	Expt. 3.
Genuine Olive Oil (of superior quality, for eating) ..	200	230	210
Genuine Olive Oil (another sample) ..	230	260	250
Commercial Oil for lubrication; believed to be genuine			
Olive Oil (3) ..	260	—	—
" (4) ..	300	—	—
" (5) ..	300	—	—
" (6) ..	310	—	—
" (7) ..	330	—	—
" (8) ..	365	—	—
" (9) ..	370	—	—
" (10) ..	370	—	—
" (11) ..	390	—	—

The results given in Table E show the influence of certain admixtures:—

TABLE E.

OIL.	Minutes required for Solidification at 25° C.	After 24 hours at 25° C.	
		Colour.	Consistence.
Olive Oil ..	230	} lemon yellow	Hard, but penetrable
" + 10 per cent. Best Nut ..	300		} Softer than pure olive
" + 20 " " ..	310		
" + 10 " Rape....	320	} pale orange } deeper orange	} Buttery
" + 20 " " ..	from 9 to 11½ hours		
" + 10 " Cotton ..	from 9 to 11½ hours	} lemon yellow	} Very soft butter
" + 20 " " ..	more than 11½ hours		

The oils used in these experiments are those most difficult of detection by the test. The "best nut oil" itself behaves very much like olive oil, so that its influence in modifying the results could scarcely have been expected to be very considerable.

Rape oil has a decided influence in retarding solidification, and also darkens the colour of the product. The effect of cotton oil is very marked.

With regard to other oils, sesame would probably (judging by experiments made at a lower temperature) be more readily detected than cotton oil, and the more strongly-drying oils would exert a still

present was about eighty per cent. more than the amount capable of absorption of the oil.

Length of time from starting.	Percentage of Iodine absorbed.
1½ hours ..	98.3
3¼ " ..	99.8
5¼ " ..	100.4
24 " ..	100.6
53 " ..	99.7

Two grammes of the same sample of rape oil were next taken, dissolved in chloroform, and diluted to

TABLE F.

Volume of N 10 Thiosulphate Solution.	cc.	cc.	cc.	cc.	cc.
(1) Corresponding to the absorbed Iodine ..	15.37	15.67	15.67	15.83	15.93
(2) Corresponding to the unabsorbed Iodine ..	3.57	7.08	10.90	11.52	18.18
Percentage of Iodine absorbed.....	97.3	99.2	99.2	100.2	100.8

greater effect. Among the latter is poppy oil, which appears to have a most remarkable influence in preventing the formation of elaidin. Some experiments which I made some time ago with a particular sample of poppy oil, showed that 10 per cent. entirely prevented solidification at 15° C., and with 5 per cent., though solidification took place, some fluid

100cc. 10cc. quantities of this solution were transferred to five stoppered bottles, and to the contents of each bottle there was added an increasing proportion of iodine solution. The bottles were then placed in a dark cupboard, and the contents titrated at the end of 3¼ hours. (See Table F.)

The results of these experiments show that, in

order to obtain the maximum absorption, it is necessary to add about double the quantity of iodine actually absorbed, and to allow the solution to stand at least from three to six, but not more than twenty-four, hours before titrating.

I have confirmed several of Hübl's figures for different varieties of oil, and have slightly extended them. The same has already been done by R. W. Moore (*Chem. News*, li. 172).

In Table G all these results are recorded side by side, and they show a very satisfactory agreement. The process is comparatively simple in execution, and may be looked upon as a valuable addition to the existing methods of assaying certain kinds of oil.

during the past three years. They nearly all represent large bulks of oil, were received at different seasons of the year, and under circumstances best calculated to ensure their genuineness.

The oils, 52 in number, are placed in the order of their *specific gravities*, which range from '9132, the lowest result which I have yet obtained, up to '9159.

7 samples have a sp. gr. below '9140
27 " " " " above '9139, but below '9150
18 " " " " " '9149, " " '9160
I have no results of oils of exactly '9160 sp. gr.

The second column in the table gives the *rise of temperature observed on mixing the oils with sulphuric acid*, and I have only included those figures which

TABLE G.

DESCRIPTION OF OIL OR FAT.	PERCENTAGE OF IODINE ABSORBED.			DESCRIPTION OF OIL OR FAT.	PERCENTAGE OF IODINE ABSORBED.		
	Hübl.	Moore.	Archbutt.		Hübl.	Moore.	Archbutt.
Linseed Oil	156 and 160	155.2	—	Castor Oil	81.0 to 81.7	—	81.3
Menhaden Oil	—	—	147.9	Olive Oil	81.6 to 81.5	83.0	82.7 and 83.9
Hemp-seed Oil.....	143	—	—	Olive-kernel Oil	81.8	—	—
Nut Oil.....	112 to 144	—	—	Sperm Oil	—	—	81.3
Poppy Oil	135 to 137	131	—	Bottle-nose Oil.....	—	—	80.4
Niger Oil.....	—	—	132.9	Nentsfoot Oil	—	—	71.9
Pumpkin-seed Oil ..	121	—	—	Bone Oil	66 to 70	—	—
Horse Oil.....	—	—	107.5	Lard	57.6 to 60	61.9	—
Sesame Oil.....	105 to 108	—	105.9	Butterine	55.3	50 and 50	—
Cotton Oil	105 to 108	108.7	105.9	Palm Oil	50.1 to 52.1	50.3	—
“Arachis” Oil..	101 to 105	—	—	Laurel Oil	49	—	—
“Ground Nut” Oil	—	—	97.6	Tallow	40	—	—
“Best Nut” Oil..	—	—	81.6	Fat from Suint.....	26	—	—
“Pea-nut” Oil..	—	87.4	—	Cacao Butter	34	—	—
Rape Oil	97 to 105	103.6	100.8 to 102.4	Nutmeg Butter ...	31	—	—
Benne Oil	—	102.7	—	Butter Fat	31	32.8; 19.54; 38.0	—
Apricot-kernel Oil ..	99 to 102	—	—	Cocoa-nut Oil	8.9	8.9	—
Almond Oil	97.5 to 98.9	98.1	—	Japan Wax	1.2	—	—
Mustard-seed Oil ..	—	96.0	—				

* The “Best Nut” Oil was a non-drying oil of sp. gr. '9163, giving a solid elaidin in seventy-five minutes at 10° C. by the method I have described. The “Ground Nut” Oil showed a decided tendency to dry, had a sp. gr. of '9192, and did not yield a solid elaidin. Both samples yielded a considerable proportion of arachidic acid by Renard's process.

† In an advanced stage of decomposition.

Rape Oil.—The most useful determinations to aid us in giving an opinion upon rape oil are—

Specific gravity.
Rise of temperature with sulphuric acid.
Percentage of alkali required for saponification.
Viscosity.
Melting-point of fatty acids.

In each of these some variation must be allowed.

In the *Chemical News* for 1874, Coleman stated that the sp. gr. of genuine refined rape oil never exceeds '9160. I am not aware that this statement has ever been called in question; and Mr. Allen, in his “Commercial Organic Analysis,” has adopted the figure. I have found it to be a practicable working limit in the examination of a large number of commercial samples; and whenever a sample has come to me from a source which I consider specially reliable, I have always found the sp. gr. fall below '9160.

I have, therefore, used this figure as my principal guide in selecting the typical samples given in Table H from among those which have passed through my hands

have been obtained with 97 per cent acid. These results may be arranged as follows:—

Sp. gr. of Oils.	Rise of Temperature observed. (° C.)
'9132—'9139.....	55°—60°:—Average, 58°
'9140—'9149.....	56—62:—“ 58½
'9150—'9159.....	55—64:—“ 59½

The third column contains the *percentage of potash required for saponification* of the oils. These results may be collected thus:—

Sp. gr. of Oils.	Percentage of KOH required.
'9132—'9139.....	17.00—17.25:—Average, 17.17
'9140—'9149.....	17.04—17.47:—“ 17.29
'9150—'9159.....	17.19—17.64:—“ 17.31

Or the figures may be arranged in this way:—

Percentage of KOH required.
17.0 to 17.1 by 4 samples.
17.1 “ 17.2 “ 12 “
17.2 “ 17.3 “ 9 “
17.3 “ 17.4 “ 14 “
17.4 “ 17.5 “ 11 “
17.5 “ 17.6 “ 1 “
17.6 “ 17.7 “ 1 “

TABLE H.

Specific Gravity at 15.5 C.	Rise of Temperature with H ₂ SO ₄ of 97 Strength (° C.).	Percentage of KOH required for Saponification.	Viscosity in Seconds at 15.5 C.	Free Acid Calcu- lated to Oleic Acid (per cent.).	M.P. of Fatty Acids by Capillary Tube Method (° C.).	Unsap. Matter (per cent.).
9132	—	17.08	—	2.1	—	—
9133	—	17.14	616	3.1	—	—
9135	—	17.00	617	2.3	—	3.3
9136	—	17.25	610	2.4	—	—
9138	55	17.25	—	4.9	—	—
9138	58	17.25	—	2.1	—	—
9139	60	17.25	—	3.1	—	—
9140	59½	17.12	—	2.5	—	—
9140	60	17.36	—	2.0	—	—
9140	57½	17.14	—	2.1	—	—
9141	—	17.20	633	1.7	—	—
9141	60	17.36	—	2.9	—	—
9141	57	17.36	—	2.6	—	—
9141	60	17.47	—	2.1	—	—
9142	—	17.04	762	1.3	—	2.9
9142	58½	17.47	—	2.1	—	—
9142	56	17.19	—	2.1	—	—
9142	56½	17.08	706	1.9	21	1.95
9142	57	17.15	—	2.3	—	—
9144	—	17.19	—	2.1	—	—
9144	—	17.19	631	1.9	—	—
9145	59	17.36	636	2.5	—	—
9145	60	17.47	—	3.4	—	—
9145	61½	17.42	620	2.2	—	—
9146	62	17.12	—	1.5	20	—
9147	—	17.39	639	5.1	19	1.25
9147	58½	17.25	—	2.0	—	—
9147	57½	17.19	—	2.0	—	—
9148	—	17.30	627	1.1	—	—
9148	57	17.19	—	2.8	20	—
9148	—	17.25	635	3.0	20½	—
9148	60	17.25	648	3.0	—	1.4
9149	—	17.41	645	4.7	—	—
9149	57	17.30	—	2.9	—	—
9150	—	17.42	636	2.5	—	—
9150	60½	17.61	—	3.3	—	—
9150	—	17.30	642	2.8	—	—
9151	—	17.19	—	—	—	—
9151	—	17.47	605	2.8	—	—
9151	58½	17.19	—	2.0	—	—
9154	63½	17.36	620	2.0	19	—
9152	—	17.30	—	—	—	—
9152	—	17.36	654	3.6	—	—
9152	56	17.19	—	3.3	—	—
9152	55	17.30	—	5.1	—	—
9156	55	17.25	—	1.3	—	—
9157	64	17.17	606	2.3	—	—
9157	—	17.58	600	4.5	18½	—
9158	61	17.50	—	2.4	—	—
9159	—	17.36	—	—	—	—
9159	—	17.19	626	5.5	20	—
9159	57	—	—	—	—	—

The great majority of rape oils, therefore, require less than 17.5 per cent. of potash for their complete saponification.

In examining rape oil, I have frequently derived considerable assistance from a determination of *viscosity*. Reference to the table will show that in no case has the oil taken less than 600 seconds to flow out of my tube; and it will be noticed that a number even so small as this is only met with among the heavier oils on the list, and those which either develop an abnormal amount of heat with sulphuric acid, or require more potash than usual for saponification. In each case where the time required was less than 625—630 seconds, there is something abnormal about the sample. Two instances will be observed in which more than 700 seconds were required. Cotton oil has considerably less viscosity than rape oil, linseed oil less still. Menhaden and other common fish oils resemble linseed in this respect.

The *Free Fatty Acid* of rape oil is seldom large. When the oil is to be used for burning, it is of the greatest importance that the proportion should be as small as possible.

The *Melting point of the Fatty Acids* of rape oil is a useful confirmatory test. The figures given in the table were obtained by the ordinary capillary tube method; but I think a far more satisfactory plan is that described by Bach, and which consists in introducing some of the acids into a narrow test tube of thin glass, and allowing them to solidify. A thermometer is then moved about in the acids, which are very gradually heated by means of a water-bath, and the temperature is observed at which the liquid becomes perfectly clear. The melted acids are next allowed to cool again, and the temperature noted at which a cloud begins to form. The principal use of the test in the case of rape oil is to detect the presence of linseed oil, whose fatty acids remain liquid at a considerably lower temperature than those of rape oil.

The "*Unsaponifiable Matter*" is the extract obtained on shaking the solution of the saponified oil with ether. It would, of course, contain any mineral oil which might be present. The determinations recorded in the table show that oils requiring as little as 17.0 per cent. of potash for saponification were free from mineral admixture.

The *readiness with which the Oil dries on exposure to air* is a further means of verifying the results of the other tests. The best way to proceed is to weigh 1 grm. of the sample on a watch glass, and an equal weight of an oil of known purity on another similar glass, and place the two glasses side by side in a water oven for 24 or more hours. Pure rape oil shows little tendency to dry at the ordinary temperature, but it becomes oxidised much more readily at 212° F. Some rape oil which I smeared on a piece of glass in October, 1883, and which has been freely exposed to the air in a cupboard ever since, is not yet dried, though it has become considerably oxidised.

Olive Oil.—The most generally useful determinations in the case of olive oil are—

- (Specific gravity.
- Percentage of free oleic acid.
- Rise of temperature with sulphuric acid.
- Percentage of potash required for saponification.
- Iodine absorption.
- Elaidin test.

I have already (*Analyst*, ix. 170), shown how very variable the percentage of free fatty acids in olive oil is, and that it may range from less than 1 per cent. in the finest varieties, up to as much as 25 per cent. It is clear, therefore, that the result of the sp. gr. test must be interpreted in accordance with the percentage of free oleic acid in the sample.

In the examination of about 200 samples of olive oil (not all genuine) mostly intended for lubrication, I have, in only two instances, met with more than 24 per cent. of *free fatty acid*, and these samples have had the lowest specific gravity.

	Free Oleic Acid.	Sp. Gr. at 60° F.
No. 1.....	25.1	9138
No. 2.....	21.5	9136

Among the remainder, the *free acid* ranged as follows:—

Percentage of Free Oleic Acid.	Number of Samples.
20 to 24	1
15 .. 10	10
10 .. 15	31
5 .. 10	66
Less than 5	19

According to my experience, the *specific gravity* of genuine olive oil containing less than about 5 per cent. of free fatty acid does not exceed 917 at 60° F.

The liability of olive oil to contain so much free fatty acid seriously reduces its value as a lubricant; but when the oil is to be used for burning, it may prove a still greater source of trouble. I discovered this fact some time ago when investigating the causes of a difficulty in burning olive oil in railway carriage roof lamps.

The following experiments were made with one of these lamps:—

1. A sample of *fine olive oil* with only 1.5 per cent. of free oleic acid continued to burn brilliantly until the supply of oil was exhausted (about 15 hours).

2. A sample of *refined rape oil* containing 2.3 per cent. of free oleic acid also continued to burn in the same lamp until the supply of oil was exhausted.

3. A sample of *oleic acid* in the same lamp commenced to burn with great brilliancy, but in a short time the flame began to fail, and in less than one hour was completely extinguished, that portion of the wick above the holder being completely converted into a brittle charred mass.

4. To the same sample of *rape oil* used in experiment 3, 5 per cent. *oleic acid* was added. The mixed oil continued to burn satisfactorily for only 4 to 4½ hours.

5. Experiment 4 repeated, gave the same result.

The following further experiments were made with ordinary olive oils:—

	Percentage of Free Oleic Acid.	Lamp began to fail in
A.	7.0	4½ hours.
B.	7.0	4½ "
C.	12.6	3½ "
D.	18.0	2½ "

These last results were not all obtained with the same lamp, and they are not strictly comparative. But they serve to illustrate the facts, which are worthy of further investigation.

With regard to the *rise of temperature with sulphuric acid*, the figures given in my remarks on Manmèn's test were not all obtained with acid of 97 per cent. strength. My experience with acid of this strength up to the present, shows that genuine olive oil gives a rise of temperature of from 41½ to 45½° C.

The *saponification value* of olive oil is useful, both as a test for rape oil, and as a means of detecting mineral oil. But I have never yet found mineral oil used as an adulterant of olive oil.

The *Elaidin test* has already been considered. What is now wanted is a number of experiments at 25° C. (and perhaps 30° C.), made in the manner I have described, on genuine olive oils from various sources.

In conclusion, I may add the following remarks:—

Earth-nut Oil of the best quality is a non-drying oil, and its presence in olive oil is not likely to seriously reduce its value as a lubricant. The only means of detecting it, with which I am acquainted, is Renard's process*, based upon the detection of its arachidic acid. The successful carrying out of this process is a most tedious operation; far too much so for it to be useful in cases where time is limited. The results of my experiments show that earth-nut oil delays the solidification of the elaidin at 25° C.; and it may be found possible to get a suspicion of its presence in that way, so that Renard's process can be used subsequently if required.

Rape Oil darkens the colour of the elaidin, besides delaying its solidification. This oil also reduces the percentage of potash required for saponification, and may be detected by means of its sulphur. Mäilho's test, which consists in boiling the oil with a 10 per cent. solution of pure potash in a silver dish, is one method of doing this; but its indications are uncertain. In one experiment I succeeded in detecting 5 per cent. of rape oil; but in two others, made with the same oil, 5, and even 10 per cent. were undetected.

Cotton Oil has a very marked influence in delaying the solidification of the elaidin at 25° C. It also raises the sp. gr. of the oil, and increases the rise of temperature with sulphuric acid.

Sesame Oil can be detected, even in traces, by shaking the oil with hydrochloric acid and sugar. 10cc. of the sample should be mixed with 5cc. of hydrochloric acid (sp. gr. 1.16), containing 1grm. of sugar in solution. The mixture is shaken for at least ten minutes, and then set aside. I have repeatedly proved that one drop of sesame oil in 10cc. of olive oil is sufficient to impart a distinct rose colouration to the acid which separates on standing.

Poppy Oil I have already referred to, and other possible adulterants call for no special remark.

Action of Light on Olive Oil.—In the *Journal of the Chemical Society* for 1871, page 1192, there is an abstract of a paper by L. Moschini (*Gazzetta Chim. Italiana*, i. 580), in which the author states that olive oil, by exposure to sunlight, is bleached, loses the property of giving a greenish colouration with acids and with caustic soda; loses also the property of forming elaidin (I suppose this is what is meant, though the abstract is scarcely intelligible), and acquires a rancid taste and odour.

Some time ago I had a sample of olive oil—a very fine sample, and of the usual yellow colour—part of which was kept in a wine bottle on a dark shelf, and part stood in a white glass bottle freely exposed to the diffused daylight (and possibly occasional sunlight) of the laboratory. This portion was found after a time to have acquired a pale green colour, while the other portion was unaltered. On further examination the following results were obtained:—

Original Oil.	Same Oil preserved in the dark.	Same Oil after exposure to light.
Free Oleic Acid	4.0%	1.0%
Rise of temperature with Sulphuric Acid	40.5° C.	52.5° C.

There was not enough oil to make any more experiments; but I hope to investigate the subject more fully, as it is one of great interest and importance.

* Some results recently obtained with this process appear to show that it requires further investigation.

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Meeting held at Cardiff, Thursday, April 13, 1886.

DR. RAMSAY IN THE CHAIR.

ON THE JAPANESE METHOD OF MAKING WHITE LEAD.

BY R. W. ATKINSON, B.Sc.

WHILST living in Japan I had the opportunity of seeing this process in operation, and so far as I am aware no one else has made any mention of it; on which account, and also because it presents some novelties, I trust I may be permitted to give a short description.

White lead is there very largely used as a cosmetic, almost every woman in Japan when fully equipped being painted on the face and neck with it to a greater or less extent. It is also very largely used by actors, especially by those who personate female characters (women not being permitted to act on the stage), and this extensive use of the material as a cosmetic offers a field for medical research on the subject of lead-poisoning which is perhaps unique.

Numerous cases are given by Dr. Taylor, in his treatise on Poisons, of lead-poisoning resulting from the use of white lead as a cosmetic, though it is proper to state that the inference drawn from these cases is disputed by M. Tanquerel, who maintains that so long as the powder does not come in contact with any abraded surface, absorption into the system does not take place. And so far as I could learn from the evidence of M. Nagayo, then Chief of the Department of Public Health in Japan, as well as from conversations with actors and medical men, none of the usual symptoms of lead poisoning have been there noticed arising from the use of white lead, although cases of plumbism occur amongst the workmen engaged in its manufacture.

The absence of injurious action may, however, be caused by the presence in the powder used for the toilet of a large proportion of starch, which would reduce the number of points of contact between the powder and the skin.

The following is a description of the method of making the white lead as I saw it carried out in the works of Mr. Murakawa, of Kiyoto, who gave me all the information I asked for with the greatest readiness.

The appearance of the plant was certainly different from anything found in this part of the world. Around the sides of the room a platform one foot high ran, and upon this, at intervals of about

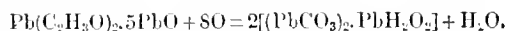
three feet, rose wooden cylinders about twelve feet high and two feet in diameter. These are built up as follows:—A good solid floor is first selected, and upon this is built a platform of brick about one foot above the ground, supported at intervals of about three feet upon brick walls, which, with the top, form a recess. In the centre of the roof of each recess a small round aperture is left to receive a coarse earthen dish which is filled with weak vinegar. The space round this dish is carefully filled up with clay, so that to all appearance there is no communication between the recess and the space above the earthen dish. Over this dish a half-barrel, about two and a half feet high, is placed, provided with an opening at the side to allow access to the dish, and usually carefully closed. About the middle of the half-barrel a bamboo grating is made, upon which the rolls of metallic lead rest. Upon the upper part of this half-barrel rests one of the tubs used for holding *sake* (Japanese rice beer) with the bottom removed and upon the top of this one another is placed, and so on to the number of four. The lower part of the barrel is a little wider than the upper part, so that the upper barrel covers the lower one to a small extent, and the space between the two is filled with clay. Before the apparatus is built up the plates of metallic lead have to be prepared. The lead used at these works was brought from Marseilles. It is first melted at a low temperature and poured upon a shallow iron dish shaped like a shovel. The contact with cold metal causes the lower part to become very quickly solid, while the upper part is still liquid. The latter is then poured away, and a thin sheet of lead is produced, one surface of which is rough and therefore presents more points of contact for the action of the vapour of acetic acid. These sheets are then rolled up and packed vertically upon the bamboo grating before-mentioned. The first hollow barrel is now placed on the top of the half-barrel and likewise filled with rolls of lead in the same way, and so on; each barrel as it is put in position is packed with lead, whilst the uppermost one is covered with a wooden cover, and the edges tightly closed by means of paper and glue. In the works visited there were 21 of these cylinders, all of which were charged at the same time. Weak vinegar is now placed in the earthen dish and a charcoal brazier introduced into the recess, so that it heats the bottom of the dish and evaporates the vinegar. The position of the charcoal fire-box in the recess is to be carefully regulated in order to avoid an excessive heat which would cause the vinegar to be wasted. Fresh vinegar is added from time to time as it is required, about $\frac{1}{2}$ -litre per day for each cylinder being the average amount. The temperature at the bottom of the cylinder was found to vary in different cases from 127° F. to 148° F. As all the furnaces were closed at the top, and removing the covers would have caused loss of vinegar, it was impossible to measure more than one, which we found to be 114° F., the temperature at the bottom of the same furnace being 132° F., a difference of 18° F.

At the end of twenty days the covers at the top are removed, and if the surface of the lead is found to be coated with a white powder the process is stopped, although the whole of the lead has not yet been converted into the carbonate. The apparatus is allowed to cool, and each roll of lead as it is removed is beaten to break off the scale of white lead with which it is covered. The scale is then placed under water in wooden tubs and constantly agitated by means of wooden poles in such a way as to reduce it to the finest possible particles; the milky liquid being then passed through fine sieves and collected in a settling vat. In the centre of this vat, which is

about three feet high by three feet in diameter, there is a cylinder of bamboo gauze, covered with fine cloth in order to prevent the passage of any solid particles into the interior, and the water which finds its way through the cloth is drawn off by means of a syphon. In this way the water is rapidly removed and a thick paste is obtained, which is further dried in shallow, unglazed earthenware dishes, about two and a half inches deep and seven inches square, piled upon one another to a considerable height. Sometimes these are placed on the tops of the cylinders in which conversion is taking place, so that they are gently heated, and by this means the cakes of white lead are more quickly dried. Before they are quite dry, the cakes are cut into square pieces for the convenience of purchasers, and covered with paper. This forms the first quality of white lead. A second quality is obtained by grinding the residue left in the vats and on the sieves in stone mills, submitting this material to levigation and drying as above described.

The weight of lead put into the twenty-one cylinders amounted to 35,000lb. The vinegar used contained 0.942 per cent. of acetic acid, and during the twenty days for all the cylinders 315 litres were used, which would, therefore, contain 11.25lb. of pure acetic acid.

No very certain information was obtained concerning the amount of white lead produced in one operation, the workmen saying that 2700lb. were obtained, and also that it filled a barrel, which was afterwards ascertained to have a capacity of $28\frac{1}{2}$ cubic feet, and when full would, therefore, hold nearly 12,000lb. of white lead. It is probable that the real number lies between the two above given; but assuming the lower one to be correct, it proves that Dr. Ure's theory is not correct even in this case, where it is not evident from what other source the carbonic acid can come. This theory supposes that a hex-basic acetate of lead is formed, $Pb(C_2H_3O_2)_2 \cdot 5PbO$, which by oxidation breaks up into the carbonate and water, thus:—



On this theory 120 parts of $H_2C_2O_2$ ought to yield 1550 of white lead, and 11.25lb. would, therefore, produce not more than 145.3lb. of white lead, whereas the lowest estimate is nearly 3000lb. The composition of the white lead produced corresponds with that prepared by the Dutch and German methods.

Oxide of lead	86.42 per cent.
Carbonic acid	11.60 " "
Water	2.00 " "
	<hr/> 100.02 <hr/>

Those familiar with the two foreign processes just mentioned will see from this brief description in what points the Japanese method differs from them. Whereas in the European methods the source of the carbonic acid is well-known, in the process carried out in Japan every care appears to be taken to exclude the gases which rise from the charcoal fire; but in the absence of any other source, I see no way to account for the successful conduct of the process except by supposing that the products of the combustion of the charcoal leak in through accidental crevices, although only in one case was I able to detect any.

The white lead is sold of several qualities, the best and second best being unmixed with any other substance, and costing 7d. and 7d. per pound respectively. The two lower priced kinds are mixed with starch in the proportion of 7lb. white lead to 10lb. of starch.

Obituary.

JAMES MUSPRATT.

ON Tuesday, 4th May, James Muspratt, the founder of the South Lancashire Alkali Industry, which has its principal seat in the neighbourhoods of Widnes, St. Helens, and Newton, with which may be included Runcorn and a portion of Flintshire, died at Seaforth Hall, near Liverpool, at the ripe old age of 93 years. He preserved his strong and characteristic faculties to the end. Not only was he a veteran manufacturer and founder of an industry, which in the districts referred to has for many years given employment to and found sustenance for hundreds of families, but he was a veteran, and a hero too, in the more literal sense, in connection with the service he saw and strove to render, and the moral courage he displayed in connection with the Peninsular War at the commencement of this century. But, in being denied the dangers and glory of a soldier's career, he was preserved for more peaceful contests on higher ground than the battlefield.

James Muspratt was born in Dublin, on the 12th of August, 1793, and received a good commercial education, which his natural quickness and aptitude of acquirement, as well as love of learning, enabled him to make the most of. At fourteen he was apprenticed to a wholesale druggist and apothecary named Mitcheltree, with whom he acquired some practical knowledge of chemistry, which served him well in later life when thrown on his own resources. At that time there were no facilities for learning science such as exist at the present day, but the intimate knowledge of drugs and chemicals, acquired in the laboratories of apothecaries, gave a practical training of no small value. From such laboratories sprang many of the most eminent chemists of the last generation, such as Liebig, Pettenkofer, and Nicholas Leblanc.

A quarrel with his master terminated the apprenticeship in 1810, and he returned home; but as his father died in or about that year, and his mother in 1811, he was left to make his own way in the world. For his mother he had a deep veneration, and she no doubt had great influence in the development of his character. His father's small property was involved in a chancery suit, and, weary of waiting for its termination, and having exhausted what little ready money he possessed, he embarked for Spain in 1812 to join the army and seek his fortune as a soldier.

In Spain, though unable to obtain the commission in the cavalry he coveted, on account of lack of influential support, and still hoping to attain the object of his wishes, he followed the track of the army far into the country, enduring the hardships and perils of a soldier's life. Subsequently he was stricken with fever in Madrid, but this his robust constitution enabled him to conquer, and narrowly escaping falling a prisoner into the hands of the French, he reached Lisbon, where he obtained a minor post on board a fast sailing warship, in which he afterwards saw some service off Brest. A less congenial post in another vessel, rendered at length insupportable by the stringent discipline imposed, compelled

him to desert his ship at the risk of his life. This successfully effected, he returned to Dublin, where he spent some short time in literary pursuits, pending the decision of the Court of Chancery with respect to a small property his father had left him. The chancery suit terminated, he found, as is not uncommonly the case with such suits, very little of the property left for division amongst the family, and Mr. Muspratt was impelled to turn again to the source first pointed out to him by his father when he apprenticed him, and now he seemed to recover his right position on the right path. He commenced the manufacture of acetic acid, hydrochloric acid, spirits of turpentine, and other chemicals, and after a few years entered into partnership with Mr. Abbot, who possessed some capital, and commenced the manufacture of prussiate of potash on a considerable scale. During this period the subject of the manufacture of artificial soda never ceased to occupy his thoughts. From one or two treatises on chemistry, such as Nicholson's Dictionary, he obtained a glimpse of the theory of the manufacture as proposed by Leblanc, and from calculations of the equivalents of the materials used and the products obtained, he saw a prospect of large profits.

But the initial stage of the manufacture—the erection of sulphuric acid chambers—required capital which he could not command. After a time he became convinced that to successfully compete with kelp he would have to remove to England, where the raw materials of the manufacture were so much cheaper. He waited some years, until he thought he had acquired sufficient capital to risk the transfer of his business to England. His partner, Mr. Abbot, would not join him in the venture, so he came over by himself to Liverpool in 1822, and in a few weeks arranged for the lease of land on the canal bank, in Vauxhall Road, and erected the works which are still in existence. The place he took was an abandoned glassworks, and the country round was quite unbuild on. Not having sufficient capital to erect suitable plant for making sulphuric acid, he continued the manufacture of prussiate of potash, and with the profits realised commenced the erection of sulphuric acid chambers. Already in Dublin he had erected sulphuric acid chambers, and by numerous improvements he eventually succeeded in reducing the cost of making the acid, part of which he sold, using the remainder for the production of hydrochloric and nitric acids, and sal ammoniac, which he obtained by treating the ammoniacal liquors from the gasworks. In 1823 Mr. Muspratt commenced the manufacture of soda by Leblanc's method. He effected considerable improvements in the manufacture of the crude soda (black ash), in which form it was first used by the soap manufacturers. Notwithstanding the difficulties he encountered in inducing the soap makers to use it, the advantages of using the stronger and cheaper soda after a time became apparent, and he was forced rapidly to increase the manufacture in order to meet the demand. The black ash was sold on the basis of 20 per cent. of alkali, but usually tested 24 per cent., and the price in or about 1824 was 12s. per cwt., equivalent to £24 per ton for 48 per cent., but by the year 1830 the price was reduced to £8

per ton in bulk for black ash of 24 per cent., and the demand continued to increase so much that he erected works in 1829 at St. Helens, in partnership with Mr. Gamble, and in 1830 commenced the large works at Newton.

For upwards of 30 years, notwithstanding the litigation in which he was engaged, Mr. Muspratt endeavoured to cheapen the cost of manufacture by lessening the price of the raw materials—coal, salt, and sulphur,—which, under the stimulus of increased demand, rapidly advanced.

In conjunction with Mr. Tennant, of Glasgow, he purchased sulphur mines in Sicily, and salt-works at Winsford.

But the litigation referred to already, was not the only difficulty Mr. Muspratt had to contend with. One of the raw materials used, sulphur, was then a monopoly of the Neapolitan Government, and in 1834–5, Mr. Muspratt, in partnership with Mr. Tennant, of Glasgow, bought some mines in Sicily, in order, by introducing improved methods of raising the mineral, to cheapen the cost of the article to the consumer. The King of Naples, with that short-sightedness common to governors, imposed a duty of £4 per ton on all sulphur exported to England, thus giving a monopoly to a French firm, Messrs. Tair & Co., of Marseilles, and, as this was a manifest infraction of the treaties, the English protested, and this protest, supported by the presence of the British Fleet, induced the king to extend the duty to all sulphur exported, which he had a perfect right to do. But neither king nor people can infringe the laws of political economy with impunity.

The effect of the legislation was that Messrs. Muspratt and Tennant, whose mines had unfortunately been inundated during the progress of the negotiations, gave up the enterprise, and looked at home for a substitute, which they found in iron pyrites, large mines of this mineral having been found in county Wicklow, Ireland. Many inconveniences and difficulties were encountered in its use, but in a short time these were overcome, and the use of native sulphur in the manufacture of alkali has long been abandoned. For a time, when the export duty was remitted and sulphur fell to its normal price, the competition between the two minerals was keen, but on the introduction of pyrites, which also contained copper, from Spain and Portugal, in the year 1857, the economical advantages were so greatly in its favour that after a time its use became universal, and about 670,000 tons are imported annually.

Mr. Muspratt, at a time when many English manufacturers depended entirely on "rule of thumb," had recourse to the best scientific knowledge of the day to improve his processes.

He engaged Mr. James Young (of paraffin celebrity), who at the time was assistant to Professor Graham, at University College, London, to superintend the laboratory at Newton and carry out experiments for improving the manufacture. One great object was to dispense with the intervention of sulphur and sulphuric acid in the decomposition of salt; and about the year 1840 Messrs. Dyar & Hemmings' ammonia-soda process was worked on a considerable scale for some years, but was ultimately abandoned, as, owing to the imperfection of the apparatus and consequent loss of ammonia, the alkali produced cost more than by the old process.

He also endeavoured, in the year 1839, to recover the sulphur from alkali-waste, under Mr. Gossage's patent, and under that gentleman's personal supervision, but the results were unsatisfactory.

It may be interesting to note the great effect produced on the prices of alkali, sulphuric acid, and sulphate of soda by the development and improvement of chemical manufacturing operations.

In 1823, when he commenced the manufacture, soda-ash was sold at the equivalent of £24 per ton of 48 per cent.; but considering the inaccuracy of the test and the improvement of the quality of refined ash, the value was nearer £30 per ton. In 1852 the price was £10 per ton, and to-day, owing to the ammonia soda competition, £4 per ton.

Sulphuric acid, when Mr. Muspratt commenced its manufacture, was 3d. per lb.; it now sells at less than 3d. per lb. Soda crystals, in 1817, were £60 per ton; they fell gradually to about £40 per ton, and are now selling at about as many shillings. Sulphate of soda (guaranteed to contain not more than 10 per cent. of salt, equivalent to about 88 per cent.) which cost, so late as 1835, £7 per ton, is now sold (guaranteed 95 per cent. and upwards) at 2s. per ton.

When we consider how indispensable each of these articles is to the manufacturing industry of the nation, some conception may be had of the boon conferred by the development of the manufacture of alkali, which was the life-work of Mr. Muspratt.

Mr. Muspratt was well acquainted with most of the eminent chemists of a former generation, and more particularly with Graham, the late Master of the Mint, and Dr. Thompson. Sir Lyon Playfair, Dr. James Young, Professor Knapp, and many others well known in the chemical world worked and gained much experience in the laboratory of his works. In 1837, when the British Association first came to Liverpool, he met for the first time Professor Liebig, and then commenced the close friendship between them which only terminated with the death of the Baron in 1873. Whenever Baron Liebig came to England he sought out Mr. Muspratt, and was his companion in several journeys through Ireland and Italy. It was natural that when the great German chemist wished to put his theories of agriculture into practice he should turn to Mr. Muspratt, who undertook the manufacture of Liebig's patent manures. An error in the theory of the way in which manures are assimilated by the soil led to the attempt to render some of the substances used less soluble; this was fatal to the commercial success of the speculation. The manufacture was abandoned, but the making of superphosphate and other artificial manure has resulted from the experiments of Liebig, carried on in conjunction with Mr. Muspratt.

From the years 1842 to 1854 Mr. Muspratt lived on the Continent, in Giessen, Munich, and Italy; since then in comparative retirement at his residence at Seaforth, now that of his son, E. K. Muspratt, Esq., the President of the Society of Chemical Industry.

He continued to the last to take a lively interest in business and politics, and his love of reading afforded him ceaseless enjoyment when failing health kept him constantly confined to his room.

During the many reactions from Liberal opinions, Mr. Manspratt remained always true to the Liberal cause. When many of his former friends at the time of the great American war were warm supporters of the South, he remained true to the principles of liberty, which were represented, notwithstanding many superficial blemishes, by the North. At the time of the great Free Trade struggle, he was prevented by his business engagements from taking a prominent part in the movement, but he was one of the first subscribers to the League, and remained through life a staunch Free Trader.

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Improvements in Registering Thermometers or Thermographs. W. Müller, London. From Carl Derckmann, Dortmund. Eng. Pat. 7147, June 11, 1885. 11d.

This invention relates to apparatus for continuously and automatically recording successive temperatures of a room or body during a certain period of time, similar to the means by which steam pressures are recorded in registering indicators. For actuating the recording pencil, the inventor employs the longitudinal expansion of a metal rod, its range of motion being multiplied by a lever or levers. The pencil marks a piece of travelling paper ruled in two directions for divisions of time and temperature, and an electric bell or other signal may be put in action by the lever to call attention to the attainment of any pre-arranged heat.—B.

An Improved Thermostatic Heat Recorder and Electric Signal. J. Gilmore, Lower Norwood, and W. R. Clark, London. Eng. Pat. 7153, June 11, 1885. 8d.

This relates to apparatus for indicating by electric signal the highest or lowest permissible temperature of any place. The inventors use a flat strip composed of two strips of metal of unequal expansion, the strip being fixed at one end, and allowed free lateral movement at the other. The free end carries a pin which comes in contact with one of two pivoted insulated metal bars according as the higher or lower limit of temperature is reached, and thereby completes an electric circuit which causes a signal to be given either by a bell or any other means. The pivoted bars are adjustable around their pivot, and are set by a dial plate to the limiting temperatures. The moving pin can also be attached to a pointer indicating on the same dial the actual temperatures existing in the place at any moment.—B.

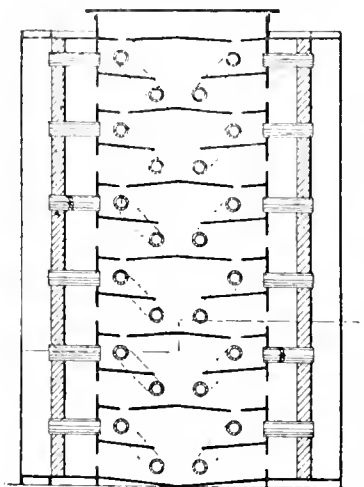
Improvements in Evaporating Apparatus. H. H. Lake, London. From J. F. Oakes, New York. Eng. Pat. 7964, June 30, 1885. 8d.

This is an apparatus for evaporating and concentrating liquids, such as dyes, by leading them through a chamber fitted with heating pipes, and through which at the same time a current of hot air or gases is allowed to pass. The accompanying figure will explain the system.

* Any of these specifications may be obtained by post, by remitting the cost price, plus postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8d.	1d.
Above 8d., and not exceeding 1s. 6d.	1d.
" 1s. 6d., " " 2s. 10d.	11d.
" 2s. 10d., " " 3s. 10d.	2d.

The inner space of the chamber carries a series of shelves down which the liquid to be concentrated is allowed to trickle, encountering in its course a serpentine range of heated pipes over which it spreads in its descent. The sides of the chamber form reservoirs for



heated air, which issues under slight pressure from the openings shown through the sides under the shelves, whilst the vapour-laden air escapes through the short tubes above these shelves, either into the atmosphere or into outer receivers.—B.

New or Improved Apparatus for and Process for Producing, Applying, and Keeping up Extreme Temperatures. E. Solvay, Brussels. Eng. Pat. 13,466, November 6, 1885. 8d.

THE inventor proposes to produce high temperatures by subjecting gases to successive compressions, the heat resulting from each compression being utilised in the compressor itself for raising the next charge to a higher temperature—the compressed air issuing finally at the desired degree of heat, for instance, such as may be required for the fusion of metals and minerals. Similarly the inventor produces intense cold by repeated exhaustion of gases, the cold resulting from each exhaustion being used to cool the next incoming charge until very great reduction of temperature is reached, such, for instance, as may be required for the liquefaction of gases.

The principal part of the apparatus consists of a pump with a very much prolonged plunger and cylinder, the prolongations leaving a small annular space between them. This space serves as passage from and to the inlet and outlet valves, and constitutes with its large surface an accumulator for the heat, or cold, as the case may be. The cylinder is surrounded by non-conducting materials, and for further particulars the specification should be consulted. The patent also embraces a reservoir for preserving liquefied gases under ordinary atmospheric pressure.—B.

II.—FUEL, GAS, AND LIGHT.

Improved Method of Expanding Gases and Vapourising Fluids by Direct Intermixture and Molecular Contact with Heated Gases. C. J. Ball, London. Eng. Pat. 4023, December 29, 1885. 8d.

THE main feature of this invention is that the liquid to be vapourised is brought into a fine spray or other state of minute division, and, in this condition, comes directly into contact with the flame and highly heated gases produced by the combustion of any suitable gas with the

required quantity of air. A pressure of 100 lb. per square inch is recommended in the gas-burner, and 90 lb. per square inch in the vessel where the spray comes into contact with the flame.—A. R. D.

Apparatus for Compressing Coal and introducing the same into Coke Ovens. H. J. Haddan, London. From Julius Quaglio, Berlin. Eng. Pat. 10,438, January 4, 1886. 11d.

The compressor consists of a portable apparatus for producing a compressed block of coal of the shape of the coking chamber. The side walls of the compressor are taken off when the block is formed, and the compressed mass is run into the chamber by a suitable contrivance, being held in position meanwhile upon the bottom of the compressor by the two ends thereof. The bottom is then drawn out, and the doors of the oven made tight.

Full details and drawings are given in the specification.—A. R. D.

Improvements in the Manufacture of Artificial Fuel and in Machinery employed therein. S. Butler, Cardiff. Eng. Pat. 4798, January 16, 1886. 11d.

This invention consists in the combination of the two processes known to manufacturers as steam and dry heat. The material passes through a steam pug, where steam is injected into it, and from here is carried by various mechanical contrivances, enumerated in the specification, over heated iron surfaces, or into contact with a hot-air blast, for the purpose of removing the moisture absorbed in the pugging process.—A. R. D.

Improvements in Gas Producers. A. Wilson, Stafford. Eng. Pat. 5880, February 15, 1886. 11d.

Air, or a mixture of air and steam, is injected through the fuel in a combustion chamber, which it enters by a vertical pipe placed inside the chamber, so that it first comes into contact with the lower portions of the fuel, and passes upward through the mass. The injector is so situated with regard to the charging hopper and poking holes that any gas escaping here is drawn into the vertical pipe and passes back to the interior of the combustion chamber.—A. R. D.

Improvements in the Purification of Air or Gases from Solid or Gaseous Impurities contained therein, and Apparatus therefor. A. Gentard, Mockau, near Leipsic. Eng. Pat. 6931, March 4, 1886. 8d.

The gases to be purified are caused to pass between wet plates of suitable material set at suitable distances from one another. The plates are either fixed or movable, as may be judged best for effecting the moistening of their surfaces in particular instances.—A. R. D.

Improvements in Machinery or Apparatus for Manufacturing Blocks of Artificial Fuel. J. Y. Johnson, London. From La Société Anonyme des Forges et Chantiers de la Méditerranée of Paris. Eng. Pat. 6884, March 5, 1886. 8d.

By a mechanical contrivance described in the specification and applicable to any ordinary moulding machine for this purpose, the blocks are made with perforations so that they can be broken up without crumbling, and at the same time allow of the economy which obtains in the manufacture of the larger sizes.—A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Recovery of Hydrocarbons from Aromatic Sulphonic Acids by means of Superheated Steam. W. Kelbe. Ber. 19, 92–94.

ARMSTRONG'S process of treatment with steam at 100° (J. Chem. Soc. 1884, 148) being said by the author to

give unsatisfactory results with, for instance, bromotoluenesulphonic acid, the author modified the process, employing instead, steam superheated by passing through a copper tube heated to bright redness in a combustion furnace. Decomposition then proceeds both quickly and regularly, water and hydrocarbon distilling over in about equal proportions. The flask containing the dry sulphonic acid, or one of its salts, with sufficient sulphuric acid (3 acid to 1 water) to decompose it and form a thin emulsion, is heated during the operation in an oil-bath from 180–220° C. As under these modified conditions the dry sulphonic acid alone is readily attacked, when using a moist acid, it is unnecessary to use an excess of strong sulphuric acid beyond that needed to bind the water. The yield of hydrocarbon was very good; as an example, from potassium bromopseudocumenesulphonate, 95% of the theoretical quantity was obtained. Bromo-derivatives obtained in this way appear to behave differently towards oxidising agents to those obtained in the usual method, being much more stable. Orthobromotoluene and bromoxylene were not at all oxidised by long continued boiling with a mixture of 1 vol. nitric acid (sp. gr. 1.205) and 3 vols. water. The author is now further investigating this behaviour.

—T. L. B.

Base Isomeric with Benzidine formed by passing the Vapour of Aniline through a Red-hot Tube. A. Bernthsen. Ber. 19, 420–425.

THE behaviour of aniline vapour when passed through a red-hot tube was investigated by Hofmann (Proc. Roy. Soc. 12, 383), and Graebe (Jahresber, 1862, 335), who isolated benzene, hydrocyanic acid, ammonia, benzonitrile and carbazole, and observed the formation of a high boiling base, but did not investigate its properties. Having repeated this reaction the author found that this oily base consists of *Isobenzidine* $C_{12}H_{12}N_2$, which crystallises in snow-white iridescent plates melting at 125°. This base closely resembles benzidine in some of its properties, but differs from it in the following reactions: Its aqueous solutions are not affected by potassium ferricyanide in the cold. With chlorine water the base gives a grey, and subsequently greyish-brown colouration, and, on standing, separates a brown precipitate. Benzidine with the first drop of chlorine water would have given a splendid blue colour, becoming on further additions bluish green, and then red. The solution of *Isobenzidine* in carbon bisulphide gives only a slight red colouration with bromine water. Concentrated nitric acid turns the base a greenish-black colour without sensibly dissolving it. Benzidine is dissolved with a yellow colour, accompanied by the separation of a white substance. The hydrochloride $C_{12}H_{12}N_2 \cdot 2HCl$ forms greyish white laminae.

Besides *isobenzidine*, quinoline, a colourless oily base and other compounds were separated from the basic oil obtained in the above reaction.—D. B.

The Presence of Methyl Alcohol in the Products of Distillation of Plants with Water. Maquenne. Compt. Rend. 101, 1067.

THE author finds that fresh plants distilled with water yield small quantities of methyl alcohol. In certain cases the quantity obtained amounts to 0.3% of the weight of the plant. About 15 to 20 kilos. of the plants are distilled with 40 to 50 litres of water. The methyl alcohol either exists ready formed in the plant, or it is produced as a decomposition product during the process of distillation.—E. G. C.

Improvements in Hydraulic Mains for Gasworks. C. D. Abel London. From F. A. M. Alavoine, Beauvais. Eng. Pat. 6257, May 21, 1885. 8d.

THIS invention consists in fixing to the dip-pipe of the ascension-pipe in gasworks horizontal sieve-like plates situated beneath the water-level in the hydraulic main, and so arranged as to subdivide the gas issuing from the dip-pipe, and to cause it to travel a long distance in con-

tact with the water. By another arrangement, the tar is made to run off simultaneously with the gas-liquor. A constant depth of the liquor is thus maintained, and the necessity for frequent cleansing is also avoided. The object of this invention is to retain in the hydraulic main a large portion of the condensible products of the gas, which is of great importance for the application of gas-works to workshops, where the great cost of condensers forms an obstacle to their adoption. With this apparatus 90 per cent. of the tar produced is said to be retained in the hydraulic main, whilst the formation of pitch is completely avoided, owing to the constant flow of the tar. An increase of from 4 to 5 per cent. is obtained in the illuminating power of the gas.—D. B.

Improved Manufacture of Turpentine from the Resins of Conifers. C. D. Abel, London. From E. Schaal, Stuttgart. Eng. Pat. 15,471, December 16, 1885. 4d.

The resins of conifers, such as fir resin, colophonium, Burgundy pitch, etc., are distilled in a partial vacuum. The distillates, passing over at a temperature of from 250–280° C., are mostly oleaginous mixtures of turpentine oil and resin oil, which are utilised in manufactures. The distillates subsequently given off at temperatures up to about 300° C., and even higher, yield a turpentine closely resembling Venice turpentine, and exceeding the same in clearness and purity. The degree of heat to be applied will depend more or less upon the size, shape and arrangement of the distilling vessels, and on the degree of vacuum employed. Similar results will be obtained if, instead of being treated in a partial vacuum, the resins are distilled in the presence of neutral gases, or of superheated steam.—E. G. C.

Improvements in the Distillation and Decomposition of Coal, Shale, and other Matters to obtain Illuminating Gas and other Products. H. Kenyon, Manchester. Eng. Pat. 1016, January 23, 1886. 6d.

THE inventor claims the following novelties:—(1) A process of making illuminating gas, consisting in the introduction of paraffin or hydrocarbon oils and superheated steam into the distilling ovens at certain stages of the process. (2) A process of making illuminating gas, wherein the distilling ovens are worked in pairs, the gases from the last-charged oven in a pair being passed into the other oven, paraffin or hydrocarbon oils being injected into the last-charged oven, and superheated steam into the other oven. (3) In order to increase the yield of ammonia in the manufacture of water- or heating-gas by the discharge of superheated steam through incandescent coke, an additional supply of superheated steam is introduced into the upper part of the oven above the coke. (4) The production of cyanides by quenching or treating the coke with alkaline solutions, and rendering the coke thus treated incandescent in a suitable chamber or furnace, and by passing superheated steam and heated air through the coke, the cyanides being recovered from the ashes by lixiviation; or, as an alternative, before withdrawing the residue from the chamber, superheated steam may be passed alone through the coke, in which case the cyanides are decomposed, ammonia being liberated. The alkali may then be recovered from the residue by lixiviation and used again.—D. B.

Improved Means for Distilling Turpentine, and for the Purification of the Crude Products of Distillation thereof. E. W. McClave, New York. Eng. Pat. 1511, February 2, 1886. 8d.

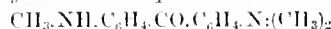
THIS invention relates essentially to the treatment of the crude products obtained from pine-wood when subjected to heat in a retort. The retort is set in a furnace in which the heat-products are distributed in order to prevent concentrated impingement on any portion of the retort subject to the ascending currents. From the condenser, to which the vapours from the retort proceed, the crude products are first caused to pass through a trap, with special contrivance for facilitating the removal of

poisonous and inflammable gases. The vapours, after condensation, are collected in settling tanks, wherein the liquid products separate in an oily and a subjacent acid portion. The oily portion is redistilled by means of steam in a suitable still, the pure turpentine thus obtained passing through a condenser to the proper receptacle. This product is obtained from the crude spirit extracted from the wood before it begins to char in the retort. The crude oils unfit for purification resulting from continuing the operation are separated by withdrawal from the tank after the first products have passed into the steaming still, the passage from the tank to the still having been closed. Besides these products, a pitchy base remains in the retort useful for paints, varnishes, and other purposes.—D. B.

IV.—COLOURING MATTERS AND DYES.

Bases of Methyl-violet and of Magenta. H. Wiechelhaus. Ber. 19, 107–110.

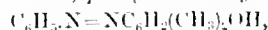
THE methyl-violet obtained from pure dimethylaniline consists of a mixture of two bases, very troublesome to separate perfectly, as the author has shown in a previous paper (Ber. 16, 2006, and this Journal, 1884, 26). The amorphous base forms salts, which dry down into yellow or copper-coloured glittering masses, and dye an intense violet with a reddish-brown tone. Owing to the rapidity with which the leuco base reoxidises, it could not be prepared in a sufficiently pure state for examination: recourse was therefore had to the products obtained by decomposing a salt of the ordinary base with hydrochloric acid. On cohabiting the hydrochloride for about 200 hours with an excess of acid, it is decomposed slowly, but completely, into dimethylaniline and trimethyldiamidobenzophenone—



This substance is a base crystallising from alcohol in groups of small acicular crystals, melting at 156°. It forms a crystalline platinochloride, and on reduction yields a hydriole. From this, it follows that the amorphous base of methyl-violet is pentamethyltriamidotriphenylcarbinol. The well-formed crystals of the crystalline base melt at 195°; they are easily soluble in ether, acetone, and petroleum spirit; less soluble in alcohol, easily soluble in CS₂, chloroform, and benzene. The salts crystallise well, and dye a blue violet. Decomposition with hydrochloric acid resulted in the formation of dimethylaniline and tetramethyldiamidobenzophenone, melting at 178°, already described by Michler and Dupertius (Ber. 9, 1900). The crystalline base is therefore *heexamethyltriamidotriphenylcarbinol*. Pararosanine and rosaniline, on decomposition in a similar manner with hydrochloric acid, both yielded the same amidoketone, CO(C₆H₄NH₂)₂, the former giving at the same time aniline, and the latter orthotolidine. The ketone is sparingly soluble in the usual solvents, crystallises from alcohol in needles, melting at 237°. The sulphate and hydrochloride crystallise well in flat needles.—T. L. B.

Azo-derivatives of Metaxylenol. E. Grevingk. Ber. 19, 148.

ON mixing an alcoholic solution of metaxylenol with diazobenzenechloride, *phenylazo-metaxylenol*—



is formed. From petroleum spirit it crystallises in fine hair-like needles of a brownish-red colour with violet reflex. It melts at 175°, is insoluble in water, easily soluble in alcohol, ether, petroleum spirit, chloroform, and benzene. Diazobenzenesulphonie acid also combines with metaxylenol in a similar way, forming a sulphonie acid, dyeing wool and silk a brownish yellow. The sodium salt is a yellowish-brown flocculent precipitate. The barium salt—



is very sparingly soluble in water. On reduction, sulphanilic acid and orthamidoxylene is obtained.—T. L. B.

Ethylparaphenylenediamine. W. Schweitzer. Ber. 19, 149–150.

PARANITROETHYLANILINE can be most conveniently prepared by heating a mixture of 14grms. paranitraniline with 11grms. ethyl bromide and 6grms. of potash dissolved in alcohol, for 3 to 4 hours in a sealed tube at 100–110°. This compound yields, on reduction with tin and hydrochloric acid, ethylparaphenylenediamine, $\text{NH}_2\cdot\text{C}_6\text{H}_4\cdot\text{NH}_2\cdot\text{C}_2\text{H}_5$. The pure base, obtained by decomposing the hydrochloride with potash, and distilling the oil obtained in a stream of hydrogen, is a yellow, odourless oil, becoming soon brown and thick, soluble in benzene, alcohol, and ether, less soluble in water and dilute potash. It boils at 261–262° under 746mm. pressure. When oxidised with phenol, α - or β -naphthol, resorcinol, etc., colouring matters of the indophenol class, are formed.—T. L. B.

Safranines. W. Schweitzer. Ber. 19, 150–153.

WITT, NÖLTING and COLLIN have shown that ethylparaphenylenediamine is capable of forming safranine. Two isomeric monethylsafranines can be obtained, which the author has investigated.

α -Ethylsafranin, $\text{C}_{18}\text{H}_{15}(\text{C}_2\text{H}_5)\text{N}_3$, is obtained by dissolving 10.4grm. ethylparaphenylenediamine and 12.7grm. of aniline, both in the form of their hydrochlorides, in 700cc. of water, with the addition of acetic acid, heating to boiling, and slowly adding 400cc. of a solution of potassium bichromate (40grms. per litre). Milk of lime is then added, the red solution filtered, evaporated to dryness, and the colouring matter extracted with absolute alcohol. The hydrochloride is a very hygroscopic bluish-green crystalline powder with metallic lustre, easily soluble in water and alcohol, but insoluble in ether. The aqueous and alcoholic solutions possess a fine olive-green fluorescence. The platinochloride forms sparingly-soluble small dark-coloured needles. By the action of silver oxide on the hydrochloride, the free base is obtained as a non-crystalline mass, with cantharidine-green reflex. The leuco base is formed by reduction with tin and hydrochloric acid; but is immediately oxidised on contact with air. The nitrate is an amorphous mass, and the sulphate forms a dark-green crystalline powder.

β -Ethylsafranin is formed by oxidising a mixture of 10.8grms. paraphenylenediamine, 7.7grms. aniline, and 12.3grms. ethylaniline dissolved in 500cc. of water, with 340cc. of solution of potassium bichromate (60grms. to the litre). The hydrochloride is an amorphous, cantharidine-green mass, very similar to the α -compound, but even more hygroscopic. The platinochloride is a dark-violet lustrous powder. The nitrate was obtained as a dark-green crystalline mass. α -ethylsafranin has greater tinctorial power than the β -compound, and dyes with a bluish shade, whilst the latter dyes brighter and yellower; the difference is best visible on silk.

—T. L. B.

Metanitrodimethylaniline, Metanitrodiethylaniline, and their Reduction Products. A. Groll. Ber. 19, 198–201.

ACCORDING to Nölting and Collin, when dimethylaniline is nitrated, only paranitrodimethylaniline is formed; on repetition of their experiments, however, the chief product was found to be metanitrodimethylaniline, whilst the yield of para-compound never exceeded 25 to 30 per cent. on the dimethylaniline used.

200grms. dimethylaniline are dissolved in 4000grms. of strong sulphuric acid in a vessel surrounded with a freezing mixture, and into this is slowly dropped a cold mixture of 193grms. nitric acid of 38° B. and 600grms. sulphuric acid, taking care that the temperature does not rise above 5°. After standing four to six hours the mixture is poured into about 10 litres of ice water, filtered from the precipitated para-compound, to the filtrate soda is added, until a red precipitate commences to be formed; the solution is then again filtered, and the filtrate neutralised with soda. The red substance is extracted from the sulphate crystals with hot alcohol, from which it crystallises in large compact red prisms.

Metanitrodimethylaniline, thus obtained, melts at 60–61°, and distils with partial decomposition at 280–285° C.; it forms a salt with hydrochloric acid, but its basic powers are less than those of the ethyl-compound. The yield obtained was from 80 to 85 per cent. on the dimethylaniline used.

Metanitrodiethylaniline is obtained on nitrating diethylaniline in a similar manner; it is a deep yellow oil, boiling at 288–290°, and easily soluble in hydrochloric acid.

Metanitrodithylaniline is an oil distilling at 268–270° under 740mm. pressure; it forms well-crystallised salts, reacts with nitrites in a similar manner to metaphenylenediamine, and yields, with diazobenzene, dimethylchrysoidine.

Metanitrodiethylaniline is a pale yellow oil, boiling at 276–278°, and in all respects similar to the dimethyl-compound.—T. L. B.

Coccerin from Living Cochineal. C. Liebermann. Ber. 19, 328.

HAVING obtained a plant of *Opuntia coccinifera* covered with the living cochineal insect, the author is able to note the presence of the above waxy substance described by him (this Journal, 1885, 585) on the living insect itself. It exudes from the wax-glands of the coccus in fine white hairs, much resembling white mould. The cocoons of the insect are also largely composed of this substance; several examined contained about 75 per cent. coccerin.—T. L. B.

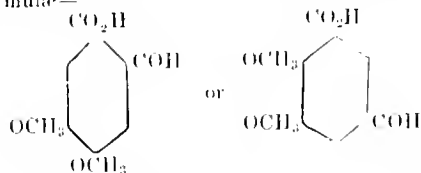
Synthesis of Xanthopurpurin and Purpurin. E. Noah. Ber. 19, 332–334.

THE above two substances are obtained by heating the following mixture for seven hours in an oil-bath at 105–110°:—1 part of symmetrical dihydroxybenzoic acid, 5 parts of benzoic acid, and 25 parts of sulphuric acid. The melt is poured into water and at once extracted with ether, which removes the unattacked benzoic acids and the xanthopurpurin. The ether is distilled off, the benzoic acid removed by steam, and from the residue the xanthopurpurin is extracted with benzene, the yield being about 6 to 7 per cent. The liquor from which ether extracted the xanthopurpurin contains anthrachrysene, of which about 40 per cent was obtained.

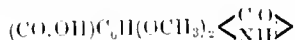
Xanthopurpurin sublimes easily in yellowish-red needles, easily soluble in benzene, forms a soluble barium salt, but does not dye mordanted fabrics. When fused with potash it readily forms pure purpurin, which precipitates on acidifying the melt.—T. L. B.

Azo-opianic Acid and a New Indigo-derivative. C. Liebermann. Ber. 19, 351–354.

ON reducing nitro-opianic acid, Prinz (*Journ. Prakt. Chem.* 24, 362) obtained an acid which he termed azo-opianic acid, and to which he assigned the formula— $(\text{CO}_2\text{H})(\text{COH})(\text{OCH}_3)_2\text{HC}_6\text{H}_3\text{N}=\text{N}=\text{C}_6\text{H}_3(\text{OCH}_3)_2(\text{COH})(\text{CO}_2\text{H})$ —although he noted that its reactions and the absence of colour hardly pointed to an azo-compound. Assuming the opianic acid to have one of the two following formulae—



—the entering nitro-group can occupy the ortho-position relatively to the aldehyde-group, and the nitro opianic acid would thus represent a further substituted ortho-nitrobenzaldehyde. According to Friedländer and Henriques (Ber. 15, 2105 and 2572), ortho-nitrobenzaldehyde yields on reduction anthranil; therefore, ortho-nitro-opianic acid should give dimethoxyanthranilcarboxylic acid—



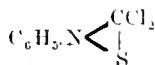
—with which substance the properties of azo-opiatic acid would better agree. That the nitro-group does really occupy the ortho-position is proved by the production of an indigo-derivative when the nitro-opiatic acid is condensed with acetone. (Comp. Baejer and Drewsen, *Ber.* 15, 2860.)

Nitro-opiatic acid, when heated to 40–50° with acetone and dilute soda or baryta-water, yields tetramethoxyindigodicarboxylic acid, $C_{16}H_4(OCH_3)_4(COOH)_2 \cdot N_2O_2$, which is a blue-green mass, insoluble in alcohol, benzene, chloroform, acetone, slightly soluble in acetic acid, better in aniline and phenol. It is sparingly soluble in boiling water, easily soluble on the addition of a little ammonia; the solution gives the indigo-carmin spectrum. With zinc-dust and alkali, it is reduced to a yellow liquid which is oxidised on exposure to the air, depositing blue flakes of the zinc salt (?); it dyes a fine blue. It does not form a sulphonic acid; the solution in sulphuric acid gives a strongly-marked absorption-band from D to F; water precipitates the colour unchanged.

—T. L. B.

Compounds of Perchlormethylmercaptan and Aniline, etc. B. Rathke. *Ber.* 19, 395–396.

IN a paper on perchlormethylmercaptan (*Ann. Chem. Pharm.* 167, 241), the author has shown that it reacts—in the first place, with aniline, thus:— $CCl_3SCl + NH_2 \cdot C_6H_5 = CCl_3 \cdot S \cdot NH \cdot C_6H_5 + HCl$. When alcoholic potash or ammonia is added to the concentrated ethereal solution of this substance, a new compound precipitates in the form of needles, which recrystallises from ether in fine prisms; to this substance the formula $CHCl_2 \cdot S \cdot OC_6H_5$ was given. Further investigation has shown that it contains nitrogen, and the analytical data given correspond to the formula $C_6H_5 \cdot N \cdot S \cdot CCl_2$. It melts at 140°, and then quickly blackens, after having already assumed a red colour at 136°. If heated quickly in a test-tube it evolves red fumes, appearing to contain azobenzene; the evolution is accompanied with slight explosion. Its constitution may be expressed thus:—



or more probably— $C_6H_5 \cdot N \begin{array}{c} \diagup CCl_2 \cdot S \\ | \\ S \cdot CCl_2 \end{array} \cdot N \cdot C_6H_5$

A similar substance is formed with paratoluidine, which crystallises from ether in white needles, melting at 138°; it is far less stable than the compound obtained from aniline; if boiled in alcohol it decomposes into a tarry mass and a red colouring matter. Orthotoluidine gives similar bodies also; in this case the compound $CCl_3 \cdot S \cdot NH \cdot C_6H_4$ is fluid, but the other body, $CCl_2 \cdot S \cdot N \cdot C_6H_4$, is crystalline, begins to melt and decompose at 134°, giving off gas.—T. L. B.

Formation of Methyl-violet with Perchlormethylmercaptan. B. Rathke. *Ber.* 19, 397–400.

THE Farbenfabrik vorm. F. Bayer & Co. obtained a patent for the production of methyl-violet from dimethylaniline and perchlormethylmercaptan. The author having been engaged previously with the study of this reaction, gives explanations of the process. One molecule of perchlormethylmercaptan reacts with three molecules dimethylaniline, preferably in the presence of aluminium chloride. On boiling out the crude melt, with water, much green tarry matter remains, which, however, is soluble in hydrochloric acid. The first crystallisation of violet from the aqueous solution yielded fine golden needles, but the quantity was small, the major part necessitating an evaporation, or salting-out, whilst a fair amount could only be obtained in the form of its very insoluble zinc double salt. Two by-products exist in these mother-liquors and in the tarry substances, consisting of dimethylaniline sulphide, $S \cdot [C_6H_4 \cdot N(CH_3)_2]_2$ (comp. Tursini, *Ber.* 17, 586), and a leuco-violet. The former is sparingly soluble in petroleum spirit, is precipitated by sodium acetate from solutions of its salts, and is oxidised readily to a blue colour; nitrites form with it a

nitroso-compound, but do not give rise to the formation of methylene-blue. The formation of leuco-violet is explained as follows:—The perchlormethylmercaptan is decomposed into carbontetrachloride and sulphur; the former reacting with dimethylaniline forms methyl-violet— $CCl_4 + 3C_6H_4 \cdot N(CH_3)_2 = (C_6H_4 \cdot N(CH_3)_2)_3 \cdot Cl + 3HCl$, whilst the latter yields dimethylaniline sulphide— $S + 2C_6H_5 \cdot N(CH_3)_2 = S[C_6H_4 \cdot N(CH_3)_2]_2 + 2H$; the hydrogen reduces the violet to leuco-violet.—T. L. B.

Diparaxylyl Ketone. K. Elbs and G. Olberg. *Ber.* 19, 408–410.

DIPARAXYLEYL KETONE $CO(C_6H_4 \cdot (CH_3)_2)_2$ is obtained from paraxylylene and carbonyl chloride in presence of aluminium chloride. The ketone is a pale yellow viscid liquid boiling at 325–327°, and soluble in alcohol, ether, and benzene. On reduction with zinc dust and alcoholic potash, *diparaxylylcarbinol* $CH(C_6H_4 \cdot (CH_3)_2)_2 \cdot OH$ is obtained, which is insoluble in water and crystallises from hot alcohol in colourless needles melting at 132°. This carbinol yields on condensation 2 : 1' : 4 trimethyl-anthracene, melting at 227°.—D. B.

The Eurhodines, a New Class of Colouring Matters. Otto N. Witt. *Ber.* 19, 441–448.

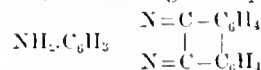
IN a previous paper (this Journal, 1885, 397) the author has described the prototype of these new bodies, which he obtained by the action of orthamidazo-toluene on a-naphthylamine hydrochloride. Instead of using naphthylamine in the melt as solvent, it is better to use phenol, from which excess of toluene precipitates the eurhodine. He now gives to this substance the formula of $C_{17}H_{13}N_3$ instead of $C_{24}H_{15}N_4$, and expresses its constitution thus:—



The free base sublimes easily, forming voluminous woolly crystalline aggregates, of a splendid orange colour. The hydrochloride forms glittering garnet-red needles, containing 1 mol. H_2O , which, however, cannot be removed without simultaneous loss of hydrochloric acid; the sulphate and oxalate have very much the same appearance, but the nitrate is almost insoluble even in boiling water.

On heating eurhodine with moderately dilute sulphuric or hydrochloric acid in sealed tubes for 3 hours at 180°, it is decomposed into ammonia and eurhodol. This base is a lustrous yellow powder, consisting of minute dichroic crystals, almost insoluble in all solvents except in aniline and phenol. It sublimes easily and possesses phenolic properties. The analysis points to the replacement of the amido- by the hydroxyl-group. Eurhodol dyes animal tissues orange. A substance, which is probably identical with the naphthyltoluquinoxaline obtained from orthotoluylenediamine and β -naphthoquinone by Hinsberg (this Journal, 1885, 511), is obtained by heating a solution of eurhodine hydrochloride in absolute alcohol, with amyl nitrite. It is a pale yellow substance, melting at 156°.

In order to settle the constitution of the eurhodines, in their relationship to the quinoxalines, the author endeavoured to obtain an amidoquinoxaline of known constitution. Phenanthrenequinone and the 1 : 2 : 4 triamidobenzene obtained by reducing chrysoidine, were allowed to react; the resulting amidoquinoxaline—



shows all the properties of eurhodine. It was not found necessary to isolate the triamidobenzene; good results were obtained in the following way. A solution of 2 grms. chrysoidine in 50cc. glacial acetic acid is prepared and reduced with zinc dust; this solution is then, after slight cooling, poured into a solution of 1 grm. phenanthrenequinone in 50cc. of glacial acetic acid; on the addition of

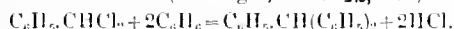
plenty of water the new compound precipitates in a slimy form, but becomes crystalline on boiling. The yield was 1.5 gm. Recrystallised from phenol and alcohol, it forms a glittering brown powder: it dissolves in strong sulphuric acid with a crimson colour, becoming, on dilution, first yellow-green and then red; it sublimes in woolly crystalline aggregates, and the ethereal solution shows the characteristic green fluorescence.

β -Naphthoquinone, benzil, isatin, diketones of the fatty series, polyketones, such as leukonic acid, form, with 1:2:4 triamidobenzene, eurhodines of varying shades.

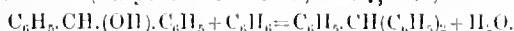
Dr. Witt considers the double $-C=N-$ chain of the quinoxalines as the "chromophor," which needs the introduction of salt-forming groups to become active. (See *Ber.* 9, 522; see also *J. Chem. Soc. (Trans.)* 1886, 391-405.)—T. L. B.

On the Aromatic Ketones. Karl Elbs. *Journ. für Prakt. Chem.* 33, 180-188.

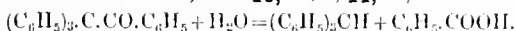
IN the prosecution of a research on triphenylmethane and some of its derivatives, the author has investigated the various known methods of preparation of these bodies, that, ordinarily employed—the action of chloroform or chloropicrin on aromatic hydrocarbons in presence of aluminium chloride—only yielding homologues in which the three hydrogen atoms are replaced by the same group. Of these methods the three following appeared the most practicable:—(1.) The action of benzyl chloride on aromatic hydrocarbons in presence of zinc dust or aluminium chloride (Böttger, *Ber.* 12, 976)—



(2.) The condensation of secondary aromatic alcohols with aromatic hydrocarbons by means of phosphorus pentoxide (Bayer and Hemilian, *Ber.* 7, 1204)—



(3.) The decomposition of the β -pinacolines by alkalis (Thörner and Zincke, *Ber.* 10, 1475; 11, 65)—



The yield by the first method was very poor, and the third was rejected on account of the difficulty of preparing pure pinacones; the second method gave satisfactory results.

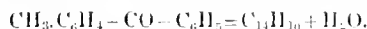
The homologues of benzophenone, from which the secondary aromatic alcohols were prepared, was obtained by the method of Friedel and Crafts, and as a number of new ketones were prepared, their properties were examined, and also their capability of forming homologues of anthracene by condensation, with elimination of water.

Preparation of Homologues of Benzophenone.—To a mixture of equivalent quantities of hydrocarbon and acid chloride enough carbon bisulphide was added to give a clear solution. An equal volume of carbon bisulphide was placed in a large flask with reversed condenser, together with a sufficient quantity of aluminium chloride. The solution was then added in small quantities at a time through the open end of the condenser, and the mixture was warmed until hydrochloric acid was no longer evolved. After cooling, water was added in small quantities in a similar manner, until the reaction was completed, and the solution was then distilled with steam. The acid from the decomposed chloride is carried over, but some occasionally remains together with the homologues of benzophenone, which are only in traces volatilised with the steam, and are left as a heavy oil or a buttery mass. The solution of aluminium chloride was poured off, and the benzophenone heated (by the introduction of steam), first with very dilute hydrochloric acid, and then with very weak caustic soda. The benzophenone was then separated, dried at 110°, and fractionated. The yield was from 50 to 80 per cent. of the theoretical. The carbon bisulphide acts as a diluent, keeps the temperature at about 50°, and prevents the formation of resinous matters. The weight of aluminium may sometimes amount to half that of the acid chloride. The reaction is complete in from half-a-day to two days. Very good results were obtained with benzene and its homologues, less satisfactory with complex aromatic

hydrocarbons. The method cannot be employed for halogen or nitro derivatives of hydrocarbons in which the hydrogen of the benzene ring is replaced; but the presence of negative atoms or groups in the molecule of the acid chloride is not prejudicial.

Reduction of the Ketones to Secondary Alcohols.—This was accomplished by dissolving one part of the ketone in 10 to 20 parts of alcohol, adding 5 to 10 parts of zinc dust, and a little concentrated caustic potash, and allowing the mixture to stand in a warm place for several days, a little caustic potash being added from time to time. The clear solution was poured off and treated with much water, and the alcohol distilled or crystallised. In the case of soluble alcohols, the potash and zinc were precipitated by carbon dioxide, and the alcohol filtered. The yield amounted to 60 to 80 per cent. of the calculated.

Synthesis of Anthracenes from Aromatic Ketones with Elimination of Water.—It had been observed by Behr and Dorp (*Ber.* 7, 17) that when orthotolylphenylketone is heated, anthracene and water are formed—



The author finds that homologues of anthracene may sometimes be formed from other ketones by a similar condensation, but he is unable at present to state whether the reaction can be considered a general one for homologues of benzophenone which contain a methyl and the carbonyl group in the ortho position. In those cases in which the formation of an anthracene did not occur, it was not brought about by the addition of reagents which usually cause condensation.

The ketones were heated to the boiling point in long-necked flasks for three to six days, and the products extracted with boiling alcohol, from which the anthracenes separated as brown crystalline powders or in crusts, and could then be purified by recrystallisation from benzene or carbon bisulphide. The residues, after evaporation of the alcohol, were again heated, and yielded further quantities of the anthracene.—S. Y.

New Process of Chlorination. A. Colson and H. Gautier. *Compt. Rend.* 101, 1064.

THE writers of this paper heat various homologues of benzene (such as orthoxylylene, paraxylylene, toluene, etc.) with phosphorus pentachloride, PCl_5 , in sealed tubes. Seven grms. of toluene heated with 30 grms. of PCl_5 yield benzyl-di-chloride, $C_6H_5.CHCl_2$. 15.5 grms. of paraxylylene be heated with 40 grms. PCl_5 , for about two hours at 195°, a substance is obtained having the formula $C_6H_4(CHCl_2)_2$, and soluble in ether, alcohol, benzene, and chloroform.—E. G. C.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

Improvements in Machinery for Treating Waterproofed Fabrics. Isidor Frankenburg. Eng. Pat. 6008, May 16, 1885. Sd.

THIS invention relates to improvements in machinery employed in the so-called "curing" of waterproofed fabrics, the object being to protect the workmen from noxious fumes and dust. This is attained by enclosing part of the machinery in a specially constructed chamber. The specification is accompanied by drawings.—E. J. B.

Improvements in the Treatment of Fibrous Substances for the Manufacture of Paper Pulp and Textile Fabrics. Robert Charles Menzies, Charles Frederick Cross, and Edward John Bevan. Eng. Pat. 6840, June 5, 1885. 4d.

THIS process consists in exposing straw or other fibrous materials which have been previously saturated with a solution containing caustic soda and sodium sulphite, and from which the excess of liquor has been drained or otherwise removed, to the action of steam. By this means a considerable economy of chemicals is effected.—E. J. B.

Improvements in Treating Webs, Wool, Rags, Waste, and the like, to be Carbonated in the so-called Wet Way, and in Dyeing the same. Moritz Iwand, and Felix Kühne. Eng. Pat. 14,393, November 24, 1885. 6d.

THE object of this invention is to do away with the expensive and troublesome centrifugal machines used for drying wool which has been previously saturated with acid preparatory to the carbonisation process. The material after having been saturated with acid is, in the form of a web, wound round a hollow perforated copper cylinder into one end of which steam is introduced. If in a loose condition the material is packed between two cylinders placed concentrically, and steam introduced into the inner one.—E. J. B.

Improvements relating to the Treatment of Silk-cocoons, Raw Silk, or the like. William Robert Lake. Eng. Pat. 1896, February 9, 1886. 6d.

THIS invention relates to a method for removing the gummy or waxy material cementing together the fibres of the cocoons, which is said to occupy much less time than the methods of fermentation and treatment with soap solutions hitherto employed. It consists in treating the cocoons with a dilute hydrochloric acid solution containing about three quarters of an ounce to the gallon, at a temperature varying from 150° to 160° F. The action should be so regulated that a certain amount of cementing material remains, as this, if entirely removed, would weaken the fibres. The process can also be applied to raw silk or silk waste.—E. J. B.

Improvements in the Method of and Composition for Treating Textile Fabrics, Cordage, Ropes, Nets, and Similar Materials. Herbert John Haddan. From the United States Waterproofing Fibre Company. Eng. Pat. 2616, February 23, 1886. 4d.

THE inventor treats the material to be rendered waterproof with a mixture obtained by melting together equal parts of rosin and paraffin wax, which may, if necessary, be thinned by the addition of fifty parts of benzene. For treating such materials as fish-nets, etc., the residue from the distillation of mineral oils may be added to the above mixture. Instead of benzene, paraffin oil or turpentine may be used as the thinning material.—E. J. B.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Industrial Society of Mulhouse. Meeting of May 10, 1886.

S. WEBER gave a further account of his investigations concerning the red colour imputed to cotton textures which have been exposed to the vapour of commercial aniline. He has found that the unbleached pieces which are coloured best are those which are coloured pink the most distinctly. These are generally fabrics made of Egyptian and Indian cottons. The red colour of the bleached goods is most marked when they have been subjected to a long treatment with chlorine. In a texture which had been bleached in the usual way, but not with chlorine, no colour could be developed. Passage through an alkali bath, after chlorinating, prevents the piece being dyed at all. The fabrics, which have been subjected to the action of chlorine and are coloured red by aniline vapours, attract basic colouring matters more readily than ordinary cotton does; whereas, no affinity was observed for acid colouring matters, or those derived from phenol. In this respect a great analogy seems to exist between Witz's hydro-oxy-cellulose and with the chlorinated bodies which Cross and Bevan have studied in connection with their investigation on the bleaching of jute. Horace Koechlin communicated to G. Galland an article on colouring matters derived from benzidine, concerning their application as mordants for basic colouring matters.—A. R.

Improvements in Apparatus for use in Fixing the Colours upon Printed Cotton Fabrics, and for Washing the same. W. R. Lake. From F. Storeh, Smichow, near Prague, Austria. Eng. Pat. 6888, June 5, 1885. 8d.

THIS invention relates to apparatus for treating printed cotton fabrics, in which apparatus the fabric is drawn through a cold fixing-liquid in a tank, then through a chamber in which by means of steam the fixing liquid is caused to act; then through one or more washing vats, rollers being arranged to squeeze the liquid out of the fabric after it leaves one and before entering another vat.—H. A. R.

Improvements in the Means or Apparatus employed in Purifying, Bleaching, Dyeing, and otherwise operating upon Yarns or Threads. J. C. Mcburn, London. Eng. Pat. 7187, June 12, 1885. 8d.

THE original should be consulted for drawings, and descriptions of an arrangement of hollow perforated or fluted cop tubes whereby the dyeing liquid, etc., is enabled thoroughly to permeate the whole mass or body of the yarn, even that which is applied against the sides of the tube.—H. A. R.

VII.—ACIDS, ALKALIS, AND SALTS.

Remarks on Mr. Mond's Communication respecting the Origin of the Ammonia Soda Process. M. Scheurer-Kestner. Bull. Soc. Chim. 45, 302.

THE conclusions of Mr. Mond require amending. A careful study of the question proves that the ammonia soda process has been gradually perfected, and that if Mr. Solvay was the first to inaugurate large and prosperous works, the labours of his predecessors were not in vain. This is borne out by the following list of patents for which the author is indebted to the courtesy of Mr. E. Solvay:—

1838.—Patent: Gray Dyar and Hemming introduced in France by Mr. Delaunay.

1840, April 1.—Mr. Canning recommends the employment of a current of carbonic acid. Applied for in France, May 18, 1840, by Mr. Delaunay.

1852, Feb. 14.—M. Grinus, of Marseilles, recommends to cool the liquors during the reaction, and employs for this purpose a freezing machine, and collects for further use the carbonic acid resulting from the calcination of the bicarbonate of soda.

1854, May 2.—Mr. Gossage urges the use of pure carbonic acid free from nitrogen or air and indicates an apparatus for its preparation.

1854, May 26.—Mr. Turek details form of apparatus.

1855, Jan. 29.—Ditto.

1855, Dec. 13.—Ditto.

1854, Jan. 21.—Mr. Schloesing gives a description of an entirely new form of apparatus, and he very clearly states the problem that one must look to improvements in the apparatus employed, and a consequent saving of ammonia.

1854, July 8.—Mr. Johnson, representing Mr. Deacon, recommends the use of carbonic acid under pressure.

1855, Feb. 28.—Mr. E. Loradoux.

1858, March 12.—MM. Schloesing and Rolland render the process automatic, and thus continuous. Their predecessors only had in view plant in which each operation took place separately without connection with those which precede or follow. They recommended and put into actual work at Puteaux, cylinders fitted with agitators for absorbing the carbonic acid. They considered the absorption was facilitated by this means. Like Mr. Gossage, they noted a considerable difference when using pure instead of dilute carbonic acid. They cooled their apparatus as M. Grinus had recommended in 1852. Their arrangements were entirely of a mechanical character. A centrifugal apparatus was employed for separating the bicarbonate with special means of avoiding the loss of ammonia, and drying arrangements enabled them to collect all the carbonic acid in a gas-holder. A limekiln produced this gas, and economical evaporators were devised by using the waste steam, etc.

1861, April 15.—Mr. Ernest Solvay.

1863, Sept. 10.—Ditto.

Besides the two principal patents, Mr. Solvay has taken out others, having reference to modifications of apparatus and other improvements. It seems that the chief improvements of Mr. Solvay on the old processes consist in the employment of novel apparatus and methods for absorbing the carbonic acid. After an exhaustive study of the laws determining the absorption of the carbonic acid by brine, he substitutes for the cylinders with agitators of MM. Schloesing and Rolland, absorbing columns of a more practical and advantageous kind. He utilises the heat disengaged in slaking the lime, and introduces a regulator separating the steam from the ammonia, and preliminary purification of the brine, the regulating the action of the carbonic acid on the brine; and he uses filter-presses, and decomposes the bicarbonate of soda by means of steam.

The list of patents taken out before Mr. Solvay entered the field, compared with his own, prove that the chemical reaction was first indicated by Messrs. Dyar and Hemming, in the year 1838. All attempts—the most noteworthy among them being MM. Schloesing and Rolland's—to render the process lucrative had been abandoned until Mr. E. Solvay established and started his works at Coniliet, in Belgium. It is beyond doubt that, if MM. Schloesing and Rolland's predecessors paved the way for a great industry, Mr. E. Solvay was the first to work the ammonia soda process so as to derive benefit from it, and to establish it on such a footing as to seriously threaten the older Leblanc process.

But, for circumstances to which I shall have to refer later, it is highly probable that MM. Schloesing and Rolland, notwithstanding their less economical process, might have established and successfully carried on this industry as early as 1858.

In his 1863 patent Mr. E. Solvay lays especial stress on the column for absorbing the carbonic acid; he declares that by his arrangement complete decomposition of the salt used takes place.

It is therefore evident that the most important points for the practical working of the ammonia soda process, as introduced by Mr. Solvay, has been the introduction of a judicious and ingenious absorbing apparatus, the regulation of the action of the carbonic acid on the brine (mixture of salt water and ammonia), and the direction given to the liquids and to the carbonic acid gas which traverses the absorbing column. These conditions have all been fulfilled by Mr. E. Solvay in a most happy manner, resulting in a more complete decomposition of the sodium chloride.

Like MM. Schloesing and Rolland, who, in this, had preceded him, Mr. Solvay has established an automatic and continuous process; but he has accomplished this by a simpler and yet more effective means.

When the carbonic acid meets the brine it is highly charged with free ammonia, and the bubbling of the gas carries away a large quantity of it. Mr. Solvay conceived the notion of reversing the two currents. He causes them to travel in the same direction, so that the liquid most highly charged with free ammonia, when meeting the carbonic acid, should be below a layer, already partially saturated, in which the ammonia carried away by the gas can dissolve.

An ingenious arrangement for the circulation of the liquid overcomes what otherwise represents the greatest difficulty of the process, so far as the absorption is concerned.

The brine first passes to the middle of the column, then to the top, and finally to the bottom of the column, whilst the carbonic acid traverses from the bottom to the top.

It is difficult to distinguish from the patents of Mr. Solvay which improvements furnish the best results, or are actual advances, as Mr. Solvay has managed to this day to carry on this great industry as a secret. Various other works having meanwhile been erected, it is, however, known that the absorbing column devised by Mr. Solvay fulfils the conditions recognised as being most suitable.

As Mr. Solvay states in his patent, it is not sufficient

merely to use pressure and cold in the absorbing apparatus, however advantageous they may be, but it is highly important to sub-divide the action of the carbonic acid so as to obtain an absorption as complete as possible without causing a disengagement of free ammonia outside the apparatus.

Be this as it may, and in spite of the immense advantage resulting from the employment of Mr. E. Solvay's apparatus, it is not less a fact that the process started at Puteaux by MM. Schloesing and Rolland could have been successfully carried out on a large scale at the very time of closing their experimental works.

The considerations which induced them not to proceed were not of a technical character. Want of capital, the duty on salt, which pressed more heavily on their industry than that of the Leblanc makers, discouraged them, although the difference did not exceed 5 to 6 francs per 100kilos. soda ash. The capitalists withdrew from the enterprise perhaps on account of this very difference of duty, however unimportant it must appear at a time when the price of soda was 60 francs per 100kilos.

Mr. Mond speaks of a cost price of 65 to 75 francs. MM. Schloesing and Rolland have not, however, indicated this figure, but a much lower one, in their communication which appeared in 1868 in the *Annales de Chimie et de Physique*.⁶

It is probable that Mr. Mond reasoned that as soda was worth 65 to 75 francs, when MM. Schloesing and Rolland were engaged in their experiments, and did not carry these experiments any further, he must conclude that their cost exceeded the then selling price. This is not so.

The works at Puteaux were merely of an experimental character, too small to be worked profitably. They were to serve as a model for a larger plant, capable of producing at least 10 tons of soda per day.

Besides MM. Schloesing and Rolland have anticipated Mr. Mond's reasoning, and have furnished in their publication of 1868 all the necessary data for arriving at the cost price, cost of raw material, fuel, labour, and such as the general charges, which they put extremely high—as, for instance, interest on money is calculated at 6 per cent., and for incidental expenses a sum of 50,000 francs is provided.

The following figures are taken from the publication of 1868:—

For 100kilos. of 99 per cent. Soda.

Salt	180.0
Limestone	135.0
Coal for heating	50.3
Coal for steam	78.0
Ammonia	1.0
Coke	72.0
Labour	1.40
General charges	9.67

These figures lead us to a cost price which is out of all proportion to that of 65 francs. Assuming that the salt was boiled out of brine, the cost would not exceed 21 francs. Using natural brine as recommended by MM. Schloesing and Rolland, the cost falls below 20 francs. The paper of MM. Schloesing and Rolland gives a perfect analysis of all the reactions; they indicate all the quantities of liquids and gases which play a part in a soda works. These particulars have nowhere else been so completely stated. It is proved from the actual selling price that the cost of soda manufactured by Mr. Solvay is less, by more than one-half, than that furnished by the figures supplied over 18 years ago by MM. Schloesing and Rolland. It is evident from the above that since 1858 Messrs. Schloesing and Rolland could have competed with the old Leblanc process, and this notwithstanding the tax on salt, which, in comparison with the latter, handicapped their product by 6 francs per 100kilos. soda.

Why then did MM. Schloesing and Rolland not carry out their project on a large scale? They answer this question in their paper of 1868: "The fiscal duties

⁶ *Annales de Chimie et de Physique*, T. 64, page 1, 1868.

causing a difference in the taxes affecting us adversely to the extent of 10 francs* per 100kilos., reduced too much the margin of profits that should exist to cover the risks that have to be encountered in starting a new industry."

The company about to be formed for carrying out this process on a large scale hesitated to face so great a difference in the tax, but oversteated by MM. Schloesing and Rolland, who overlooked the fact that the Leblanc process demands much more than the theoretical quantity of salt. MM. Schloesing and Rolland abandoned, therefore, their scheme, not on account of defect in their process, but owing to their over-estimating their difficulties. Such at least is the author's conviction after carefully studying the question. He arrives at the following:—It is clear from the patents:—

(1.) The chemical process of manufacturing carbonate of soda from sea-salt by the agency of ammonia has been known since the year 1838, and even before that date according to some authorities. Messrs. Harrison, Gray Dyar and Hemming were the first to publish the reaction in their patent of 1838.

(2.) Several attempts were made in England between the years 1838 and 1855 to work the process on a large scale, but the works built for this purpose were closed one after another because the soda produced cost more than by the Leblanc process.

(3.) In 1855 MM. Schloesing and Rolland, like several Englishmen had done before them, erected plant at Puteaux. Their establishment was merely experimental, not a working plant. According to the account and data given by MM. Schloesing and Rolland, the soda produced by their process at Puteaux could compete as regards cost with that produced by the Leblanc process, but the enforcement of vexatious and unwise salt taxes discouraged promoters of the enterprise, who, had they been better informed, might have successfully competed with the Leblanc process.

Since the year 1861, Mr. E. Solvay succeeded, by dint of perseverance and ingenuity, in completely remodelling the mechanical portion of the process, and in consequence in considerably reducing the cost of production.

He founded at Couillet, in Belgium, the first extensive ammonia soda works. His process is original, and notwithstanding the labours of his predecessors we must consider him the true founder of a cheap soda process. He has rendered a great service to the world—not, however, without dealing a severe blow to the old soda industry. One may ask whether, without the labours of Mr. Solvay, the production of soda by the ammonia process would have remained a long time without practical application. I have little doubt on the point. The serious checks, attributable to diverse causes, which arrested and cut short experiments prior to those of Mr. Solvay, would certainly for a long time have deterred chemists and engineers from this field, to the great detriment of a number of industries depending on the soda manufacture.

On the Use of Pyrites in the Manufacture of Sulphuric Acid, and on Progress made in the Burning of this Ore. Scheurer-Kestner. Bull. Soc. Chem. 45, 227.

THE author gives a historical sketch on the use of pyrites in the manufacture of sulphuric acid. He claims that this mineral was first employed in France for the above purpose, and that the best methods for utilising the sulphur it contains are also due to French manufacturers, notably to M. Perret. A description follows of various furnaces used at different periods for burning pyrites. Perret has recently constructed a new furnace for crushed ore, which has the shape of a prism, and resembles Gerstenhöfer's, being however free from the defects of the latter. The working of this furnace has hitherto been most satisfactory; the pyrites are thoroughly utilised and much labour saved, the cost of the latter being reduced by one-half.—A. R.

* The calculation shows barely 6 francs.

Schloesing's Law relating to the Solution of Calcium Carbonate by Carbonic Acid. R. Engel. Compt. Rend. 101, 949.

THE author states, in opposition to Caro's assertions, that Schloesing's law as to the solubility of calcium carbonate in water saturated with carbonic acid holds good, not only for pressures less than one atmosphere, but for higher pressures. The law also applies to barium carbonate.—E. G. C.

Manufacture of Sulphocyanides. F. Nafzger. Chem. Zeit. 10, 370.

THESE salts are finding an increased application for various purposes in dyeing and printing, as well as for the manufacture of colours. The sulphocyanides are not generally obtained from gas liquor, unless the latter has a specific gravity corresponding to 10–15° B., and this being of rare occurrence, "Laming's ferric oxide mass" has been used of late years for their preparation, as it sometimes contains 10 to 12 per cent. of ammonium sulphocyanide. This salt is always mixed with ammonium salts, and the best method of separation—viz., that of partial crystallisation—is connected with considerable difficulty and loss. Numerous patents have been taken based on the preparation of sulphocyanides from the residue of the Laming's mixture, with subsequent removal of the sulphur of the compound and formation of ferrocyanides. But as regards relative values of these two salts, it would be more rational to endeavour to prepare sulphocyanides from ferrocyanides. The manufacture of sulphocyanides can only be carried on profitably in works where certain other products, such as ferrocyanides, Prussian blue, etc., are prepared, and where the process is under the supervision of experienced chemists. (Gasch, Chem. Zeit. 10, 274). In connection with this matter the author draws attention to the method known as the "liming-process," used in England in some gas works, whereby the nitrogen of the coal is more fully utilised.—A. R.

Improvements in effecting the Decarbonation of Earthy Carbonates, such as Carbonate of Barium, Carbonate of Strontium, and the like, and Apparatus therefor. W. L. Wise, London. From R. Radot, Paris. Eng. Pat. 5280, April 28, 1885. 8d.

IT is proposed to effect the reduction by the combined action of reducing carbonated gaseous agents and superheated steam. In practice this may be carried out in many ways—either by the employment of a carbonated gas, which heats and reduces the material at the same time; or by the employment of hydrogenated gas, which heats the material and produces by its combustion the superheated steam necessary for reduction; or by the employment of a hydrocarbonated gas; or by the employment of any suitable combustible gas mixed with steam; or, lastly, by the employment of a liquid or solid hydrocarbon or of water-gas. The decarbonation is best performed in a furnace of the crucible type, or in a reverberatory furnace analogous to those employed for melting glass. In either case the process is continuous; the material to be acted upon is fed from the top, and gradually slides downwards until it arrives on the hearth proper, where it is exposed to the heat and the reducing gases, which are passed into the furnace by one or more tuyères. The reduced mass is withdrawn at the bottom. Instead of feeding the furnace with the pure carbonate, it is often preferable to add to it a small quantity of pure carbon or pure carbonaceous material, as under its influence the decomposition takes place more rapidly and at a lower temperature than would otherwise be the case.—S. H.

Improvements in the Manufacture of Hyposulphates and Sulphates of Alkalis. H. B. Condy, London. Eng. Pat. 5388, May 1, 1885. 6d.

THE process depends on the conversion of chloride, nitrate, or acetate of sodium or potassium into hyposulphates (dithionates) of either of these alkalis by treating

them with manganese hyposulphate (dithionate) in aqueous solution. The latter is prepared by treating sulphurous acid in solution with manganese dioxide. On mixing the two solutions in equivalent proportions, nearly the whole of the alkali contained in the alkaline salts is obtained as hyposulphate, the latter being only slightly soluble in solutions of chloride, nitrate or acetate of manganese. For the subsequent conversion of sodium or potassium hyposulphate into very pure sulphate it is only necessary to dry the salt and heat it to redness.—S. II.

Improvements in the Utilisation of Certain Residuals obtained in the Manufacture of Copper and Alkali. C. Wigg, Liverpool. Eng. Pat. 5620, May 7, 1885. 6d.

THE object is to provide efficient means for utilising the spent liquor obtained in the extraction of copper by the wet process, and also the vat waste of the Leblanc process. Spent copper liquor which mainly consists of sodium sulphate and chloride, and iron in various forms, is treated with ammonium sulphide until all iron is precipitated. The precipitate is then filtered, dried, and burned in the usual pyrites kilns. The iron peroxide left may be prepared for use as a pigment, and the sulphur dioxide given off disposed of in any convenient manner. The filtrate, now consisting of sodium sulphate and chloride, and ammonium salts in solution, is passed into apparatus for the formation of sodium carbonate. The ammonium sulphide required in the process is produced by the decomposition of vat waste with an acid and passing the gas into ammoniacal liquor.—S. II.

Improvements in the Production of Nitrate of Ammonia and Bicarbonate of Soda. J. F. Chance, Birmingham. Eng. Pat. 5919, May 14, 1885. 6d.

THE invention consists of a mutual decomposition between sodium nitrate, ammonia and carbonic acid. Sodium nitrate is dissolved in water, which is made slightly alkaline by some of the washings produced in a later part of the process. The solution is filtered and treated with an equivalent of ammonia. Such mixture is then subjected to a current of carbonic acid under pressure when there ensues a decomposition producing sodium bicarbonate and ammonium nitrate.—S. II.

Improvements in the Purification of the Alkaline Lays known as Tank or Vat Liquors. J. F. Chance, Birmingham. Eng. Pat. 5920, May 14, 1885. 6d.

IT is proposed to remove the sulphides by treating the liquor with a mixture of oxides or carbonates of iron and lime or carbonate of lime, prepared by precipitating a solution of iron chloride with a considerable excess of lime, or with a mixture of lime and carbonate of lime. The mixture is introduced into a vessel where by violent agitation it is brought into intimate contact with the liquor, the sulphides of alkalis being thereby readily converted into the hydrate and carbonate, the sulphur forming insoluble iron sulphide, which is separated by filtration. The purified lays are then treated in the usual manner.—S. II.

Improvements in the Production of Alkaline Phosphates in the Manufacture of Iron or Steel from Phosphoric Pig Iron. T. Twynam, Middlesbro'. Eng. Pat. 6867, June 5, 1885. 6d.

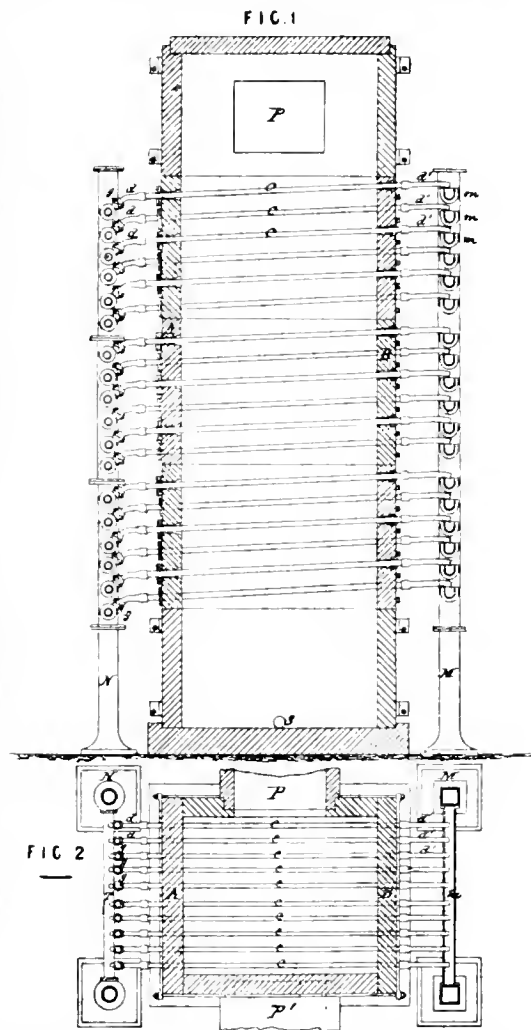
THIS invention relates to the manufacture of alkaline phosphates during the conversion of phosphoric pig iron into iron or steel. It is proposed to add in the converter or Siemen's furnace either trisodium or tripotassium phosphate or an alkaline phosphate containing three equivalents of a base for every equivalent of phosphoric acid. This tribasic phosphate is best obtained by fusing the alkaline phosphoric slag with sodium carbonate. In the furnace or converter the trisodium phosphate is converted into the monosodium salt, which by a subsequent fusion with alkali is reconverted into the trisodium compound.—S. H.

Improved Apparatus for Facilitating the Dissolution of Oxide of Lead and other Substances used for making Lead Salts for the Manufacture of White Lead, etc. A. W. Anderson, London. Eng. Pat. 12,891, October 27, 1885. 5d.

THIS apparatus consists of a horizontal cylindrical drum, which may be either stationary or revolving, provided with an internal revolving shaft or axis, fitted with stirrers or paddles.—E. G. C.

Improvements in Apparatus for Cooling Gases and Vapours. W. F. Weldon, Cambridge. From A. R. Pechiney & Co., Salindres, France. Eng. Pat. 6066, May 18, 1885. 5d.

THIS invention concerns an improved apparatus for cooling gases and vapours which are capable of attacking metals—viz., free chlorine, hydrochloric acid, etc. It consists essentially of a stone tower of rectangular horizontal section, in the interior of which tower are arranged, either horizontally or in an inclined position,



glass tubes, through which cold water is kept flowing. In Figures 1, 2 and 5, the glass tubes are marked *c*. One extremity of each tube protrudes through the A side of the tower, and its other end protrudes through a corresponding hole in the B side of the tower. On the A side of the tower the end of each glass tube is connected by a piece of caoutchouc tubing *d* with pipes T. Water passes into the pipes T from the hollow column X, and then

from T into the glass tubes *c*. On the B side of the tower each glass tube is connected by caoutchouc tubing *d'* with an open gutter *m* into which the water from the glass tubes is discharged, passing away by the hollow column M. The inclined position of the glass tubes is necessary to ensure their being always filled with water. Figures 3, 4, and 5 represent the joint between the glass tubes and the stone sides of the tower. It consists of caoutchouc pieces *i*, which are tightly pressed against the stone by means of bolts and glands *n*. The gas, or mixture of gases and vapours, to be cooled by this appa-

ing the lead. The filling proper consists of pieces of quartz, which are made to press strongly against the lining of quartz powder, all the holes and cavities along the edge being filled up with spalls of quartz. In lieu of the usual fire-brick arch, there are two posts of quartz, which carry blocks of quartz, spanning the spaces between the walls, some spaces being left open for the passage of the gas and the acid. On the top of these cross-pieces, and at right angles thereto, are placed smaller pieces of quartz, and above this series the filling proper is built up.—S. H.

FIG. 3.

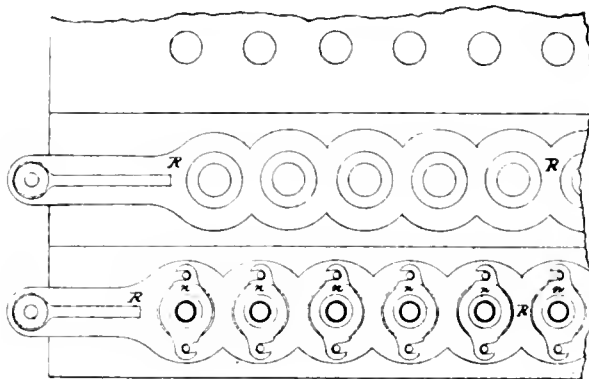


FIG. 4.

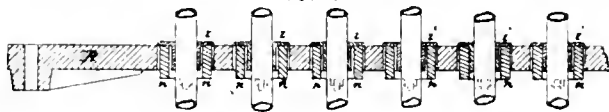
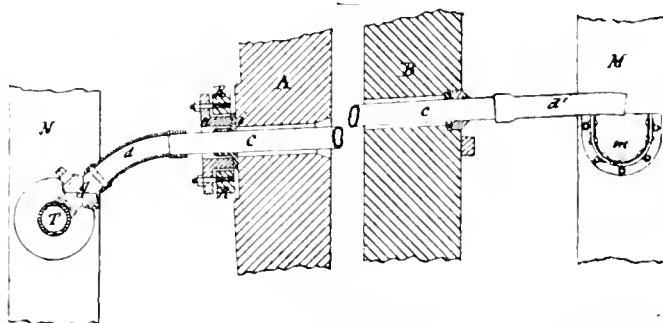


FIG. 5.



ratus enters near the top of the tower at P, and the cooled gases pass off near the bottom on the opposite side at P'; any liquid condensing runs out at S. If one of the glass tubes happens to break, it can be readily removed and a new one put in its place without stopping the working of the apparatus.—S. H.

An Improved Sulphuric Acid Tower. Nichols and Herreshoff, Brooklyn, U.S.A. Eng. Pat. 1861, February 9, 1886. *Sd.*

THE main difficulty connected with the use of a Glover tower is caused by the brick lining and the lower brick arch not being able to withstand the severe action of the hot acid gases and of the hot acid. The bricks are gradually eaten away, shortening the life of the tower and rendering the acid impure. The present invention seeks to obviate these difficulties in proposing to line the tower within its outer sheeting of lead with quartz, and constructing the lower part of the tower entirely of quartz. It being impossible to cut quartz into blocks in such a manner as to form a self-sustaining wall, the quartz is crushed to so fine a powder that it will pack closely enough to prevent the hot gases from reach-

Improvements in the Extraction of Nitrate of Soda and other Salts. M. R. Pryor and A. C. Jameson, London. Eng. Pat. 2233, February 16, 1886. *Sd.*

THE object of this invention is the economical extraction of soluble salts from their native earths by a continuous process. The apparatus consists of an Archimedian screw fixed inside an inclined tube. This tube is caused to rotate with the screw whilst a stream of cold water flows into it at the higher end. The lower end of the tube takes up at each revolution a portion of the native earth which is slowly worked up the tube and passed out at the higher end, leaving the soluble salt in the water. The latter enters in a continuous stream at the higher end and passes out at the lower end, where it overflows into a spacious tank in order to deposit any insoluble matter carried away by the current. If it be desired to treat the native earths with hot water, the apparatus can be readily modified accordingly.—S. H.

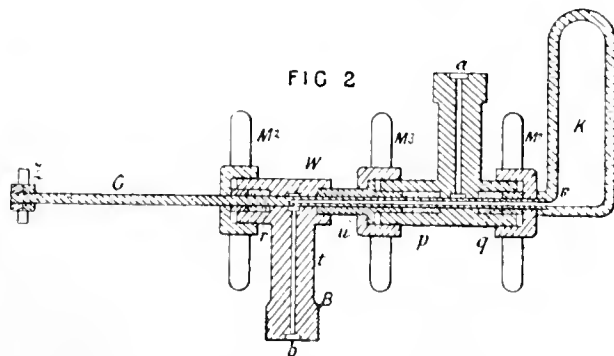
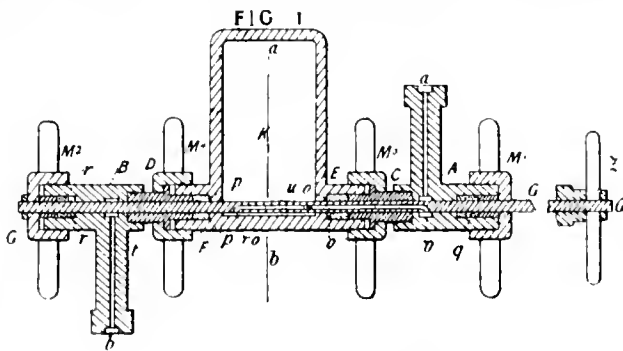
An Improved Measuring Apparatus for Liquid Carbonic Acid. E. Lühmann and C. G. Rommenholler, Niedermendig and Rotterdam. Eng. Pat. 2262, February 16, 1886. *Gd.*

THE apparatus is shown in the accompanying drawings (Figs. 1 and 2). It consists essentially of a sliding rod G,

which can be worked air-tight through several stuffing boxes. Through the centre of the sliding rod for a distance extending from *e* to *w*, and with openings at these points, is a passage *u*. According as the rod *G* is moved forwards or backwards, the central passage connects a measuring vessel *K* with lateral channels *a* and *b*, which serve respectively as inlet and outlet for liquid carbonic acid. The modification shown in Fig. 2 is a simple form of apparatus, the measuring vessel *K* being firmly fixed

Amalgam or Cement capable of being Moulded or Pressed while in a Plastic Condition. J. Cawley, London. Eng. Pat. 2806, March 3, 1885. 6d.

AN argillo-calcareous clay from the neighbourhood of Boulogne is mixed with either marls or clays, in order to secure a perfectly homogeneous mixture of calcium carbonate and clay, as well as with other well-known cements. The argillo-calcareous rock is first crushed



on the end of the sliding rod *G*, and the central passage *u* opening directly into *K*. By moving the rod *G*, the measuring vessel is alternately connected with the inlet and outlet passages *a* and *b*.—S. H.

and then burnt: and, after mixing, the stone is burnt, again crushed, and finally sifted.—E. G. C.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Improvements in the Manufacture of Cement. W. Joy, Northfleet. Eng. Pat. 9154, January 30, 1885. 6d.

WET slurry, or a mixture of wet slurry and fuel, is charged into the cement kiln while the kiln is in action, the wet slurry, or the mixture, being deposited in successive portions on the burning charge as the burning proceeds, and at the parts where for the time being the charge is burning most freely.—E. G. C.

Production of Surfaces resembling Marble, Malachite, or other Stone on Tubular or other Hollow Objects or Bodies of Glass. J. Budd. Eng. Pat. 642, January 16, 1885. 6d.

THE inventor prepares the inner surface of hollow tubes, cylinders, etc., of glass, in imitation of marble, malachite, or other stone; the said glass is then provided with an internal lining of wood or other suitable material, if desired, with headings of brass, etc. In the case of cylinders or tubes to form pillars or pedestals, a wooden or other core is used, and the space between this core and the inner surface of the glass is filled with sand or other suitable substance.—E. G. C.

Improvements in the Manufacture of Artificial Stone. J. H. Johnson, London. From Ignay Brandstätter, Vienna. Eng. Pat. 3897, March 26, 1885. 6d.

PURE quartz, and similar materials, are ground and sieved, and mixed with magnesia or (if a higher degree of hardness be desired) with minium or litharge. Chalk, marble, or limestone is also used for some purposes. Twelve to sixteen parts by weight of a concentrated solution of silicate of soda are then added. The mixture is next poured into moulds, and submitted to a high pressure in a hydraulic or other press. Finally, the moulded and compressed stones are dried, burnt in an oven or kiln, and carefully cooled.—E. G. C.

Luminous and Damp-proof Cements. E. Ormerod and W. C. Horne, Battersea Park and Charlton. Eng. Pat. 3916, March 27, 1885. 6d.

LUMINOUS sulphide of calcium, in powder, is mixed with Keen's, Parian, or other suitable cement in varying proportions. The luminous cement so made is moulded into the required form, dried, and either placed in a bath of paraffin-wax and benzoline, or brushed over with a solution of paraffin-wax or other suitable damp-proofing material.—E. G. C.

Improvements in the Manufacture of Cement. F. Ransome, Norwood. Eng. Pat. 5442, May 2, 1885. 8d.

THE cement material is reduced to the state of a fine powder before it is passed into the burning chamber.

The latter consists of a slowly-revolving receptacle heated by the combustion within it of gas obtained from coal, coke, petroleum, or other hydrocarbon, in a gas producer of any suitable construction.—E. G. C.

Improvements in the Manufacture of Cement and Lime. H. Matthey, New York. Eng. Pat. 14,064, November 17, 1885. 4d.

INSTEAD of first making up the different constituents of Portland cement into a pasty mass or "slip," and then making bricks, which require to be dried either naturally or artificially before calcination in the kilns, the inventor grinds together the proper proportions of the several ingredients, and then feeds the fine powder so produced into a heated receptacle, which is kept constantly moving so as to agitate and disseminate the particles. Plaster of Paris is prepared in a similar way, the gypsum being at once ground to a fine powder and then calcined as described. For the manufacture of ordinary lime, the rock is first crushed so as to pass through a No. 4 or No. 6 sieve, and then conveyed directly to the heated and moving receptacle.—E. G. C.

Improved Process of and Furnace for Burning Lime and similar Materials. P. M. Justice, London. Eng. Pat. 15,252, December 11, 1885. From Carl Dietzsch, Malstatt. 6d.

THE process consists in first heating the limestone, lime, or similar substances by means of the escaping heat from the furnace, then adding fuel to the heated mass as it sinks down into the burning chamber, and then cooling, or partially cooling, the mass before withdrawing it. The furnaces are constructed so as to possess a preliminary heating chamber above, connected by inclined shoots or channels with one, two, or more burning chambers beneath. The lower parts of the burning chamber or chambers are contracted into a funnel shape towards the bottom, and form the cooling portion or zone of the main chamber.—E. G. C.

X.—METALLURGY, Etc.

Production of Antimony in Blast Furnaces. C. A. M. Balling. Chem. Zeit. 9, 1825.

THIS process is worked at Banya, in Hungary, where the crude antimony obtained possesses a composition indicated by the following figures:—Sample No. 1. Sb = 91.02, Fe = 6.23, S = 2.85. No. 2. Sb = 73.80, Fe = 16.66, S = 8.42. No. 3. Sb = 65.04, Fe = 23.80, S = 10.46. These figures show the differences between the three kinds or qualities of crude antimony obtained. The two first kinds are refined in a reverberatory furnace, and the third quality is returned to the blast furnace. The proportions obtained of these three sorts of crude antimony are, respectively, 82.5, 9.0, and 8.5. The slag produced has the following composition:—1. SiO_2 = 46.9, CaO = 34.6, FeO = 15.1, Sb = 0.5. 2. SiO_2 = 45.5, CaO = 31.4, FeO = 19.9 and Sb = 0.9.—E. G. C.

Improvements in the Machinery and Appliances for Treating, Dressing, and Cleaning Tin and other Mineral Ores, and in Modes, Means, and Processes connected therewith, and for other useful purposes. G. M. Edwards, London. Eng. Pat. 6347, May 23, 1885. 11d.

SEVERAL arrangements are detailed for washing tin slimes. First, the slimes are to be passed over an inclined stepped plane, set in a wooden frame in the successive recesses formed by the steps of which the tinstone will be deposited, and will, moreover, be graduated into various sizes, each recess collecting a smaller mean size than the preceding one. By a simple arrangement of pivoted partitions (only brought into use when required) the various qualities may still be kept separate when it is necessary to clean up the frame. Next, the slimes may be passed through a funnel, delivering at a depth of

two-thirds of the total height, into a cylinder of clear water. The heavier particles will sink, those which are lighter being carried away by the water overflow. Or they may be introduced into a tall cylinder of water containing a central rod, carrying at its lower end a propeller screw. Over this rod slides a deep plunger, the diameter of which is two inches less than that of the cylinder, and which is actuated by a hand lever. When the slimes are thus introduced, the propeller blades are rapidly revolved until the whole of the ore is by agitation got into suspension; the whole is then allowed to stand quietly until it is judged that all the tin has settled, and the plunger is then lowered and displaces a part of the water with the gauge still in suspension. When, by repetition of the process, the slimes have lost about 40 per cent. of their original bulk, they are divided into two parts by means of a double cylinder, the upper half of which fits accurately upon the lower, but may be made to slide from it laterally along a grooved channel. The heavier portion in subsiding takes the lowest position, and thus the lighter portion above is removed with the upper half of the cylinder.—W. G. M.

Improvements in Concentrating or Washing Apparatus for the Treatment of Ores or other Materials. P. M. Justice, London. From The Frue Vanning Machine Co., Detroit, Michigan, U.S.A. Eng. Pat. 6758, June 3, 1885. 8d.

SUPPORTED by freely-swinging legs within a substantial framework, is a long rectangular frame of light construction, to which a rapid longitudinal oscillation is constantly imparted by a connecting rod communicating with an eccentric. Around this frame, which is placed not quite horizontally, is stretched an endless flanged belt, preferably of smooth surfaced rubber. This belt rests on a series of transverse rollers above the frame. Passing over a drum at the higher end, it is then belled beneath, so that it shall traverse a water tank, by means of a second drum; it is restored to the level by passing over a third, and finally re-attains the top over a fourth placed at the lower extremity of the frame. A slow travelling motion is imparted to the band by connecting one of the pulleys by suitable gearing with the shaft which drives the oscillator eccentric: the band thus travels (above the frame) up the incline, near to the top of which is an ore distributor delivering the pulp evenly over its surface, and higher than this is a row of clear water jets reaching across the frame. Thus by the action of the water, aided by the oscillation, the heavier matter sinks to the bottom and is carried onward by the band, and eventually washed off in the tank beneath, whilst the lighter gangue is swept forward and downward and deposited in a launder at the lower end. Where tailings from amalgamation of gold ores are to be concentrated, the mercury is caught in the distributor by riffles and an amalgamated copper-plate.—W. G. M.

Improvements in the Manufacture of Steel. John Gjers, Middlesborough. Eng. Pat. 6873, June 5, 1885. 6d.

THE principle of forcing of carbonic oxide, alone or with nitrogen, through steel in a converter, as described in Eng. Pat. 6484, 1884, is extended to steels made otherwise than by the pneumatic process. In the open hearth furnaces the gas is introduced into the metal bath by means of a hollow rabble; in the crucible or ladle by a steel or iron pipe passing to the bottom of the metal and protected (or not) by a refractory covering, the diameter of the pipes being in the former case 4-inch, in the latter 1 inch.—W. G. M.

Improvements in Preparing Ores, Oxides, or Compounds of Iron for Smelting or Reducing. John McCulloch, Airdrie, Lanark. Eng. Pat. 6894, June 8, 1885. 4d.

THE ore or oxide, well dried and pulverised, is mixed with coal or coke in the proportion of from one to three equivalents of ore to one of carbon, and with dry calcium carbonate or other flux, and sufficient pitch to ensure agglutination; the mixture is then moulded and pressed

into bricks, preferably by the apparatus described in Eng. Pat. 9591 of 1885, and is then ready for use in the blast furnace.—W. G. M.

Improvements in the Manufacture or Treatment of Iron and Steel. J. H. Johnson, Lincoln's-Inn-Fields. From La Société Anonyme "Le Ferro-Nickel," Paris. Eng. Pat. 7179, June 12, 1885. 6d.

To a charge of melted soft iron or steel is to be added a mixture of about 1 per cent. of manganese, 0.5 of potassium ferrocyanide, and 0.05 of aluminium, with the object of increasing the tenacity of the metal. If, at the same time, it be desired to render it less oxidisable, malleable nickel to the extent of from 3 to 25 per cent. (according to the degree of inoxidisability required) is also to be used. Carbon may be wholly, or in part, substituted for the ferrocyanide; but with less satisfactory results.—W. G. M.

Improvements in the Manufacture of Steel Converter Bottoms, Plugs, or Blocks. Geo. Jarvis, St. George's, Salop, and Alex. E. Tucker, Smethwick. Eng. Pat. 7571, June 22, 1885. 4d.

SLAG from the blast furnace or the converter, alone or fused with other refractory bodies, is run direct, or after remelting, into moulds of the required shape and containing tubes or pins to give the requisite perforations. These blocks may be afterwards annealed if necessary.—W. G. M.

XI.—FATS, OILS, AND SOAP MANUFACTURE.

Ammoniated Soaps. C. R. Huxley. Eng. Pat. 3441, March 17, 1885. 4d.

A SOAP made from 8 parts of stearic acid, 4 cocoa-nut oil, 1 potash, 1 soda, 6 water, is cut into shavings and placed in a retort in which is a pressure of 15lb. per square inch of ammonia gas until thoroughly permeated with it.—W. L. C.

Improvements in the Distillation of Glycerine, and in Means or Apparatus employed therein. A. G. Brookes. Eng. Pat. 5382, May 1, 1885. 8d.

THE still and superheating coil are heated by the same furnace, and the former is connected with condensing coils which terminate in vacuum pans large enough to hold the whole charge. The series of condensing coils ends in a surface condenser connected with a vacuum pump, and kept cold by streams of water which do not mix with the condensed glycerine. A drawing is given.—W. L. C.

An Improved Soap-paste for Cleansing Woollen and other kindred Fabrics. M. S. Gosling. Eng. Pat. 5998, May 15, 1885. 4d.

ONE part of borax, and 32 parts of Castile soap are incorporated with water into a thick paste, and a fragrant essence is added.—W. L. C.

A Lubricating Powder for Machinery. A. M. Clark. From B. Lenglet, Amiens. Eng. Pat. 670, January 15, 1886. 4d.

POWDERED talc or kaolin is incorporated with paraffin, spermaceti, wax, etc., to produce a white lubricating compound, for machinery employed in making white fabrics, such as tulle, etc.—W. L. C.

Improvements in Lubricating Compounds. C. Fink. Eng. Pat. 1525, February 2, 1886. 4d.

WITH any animal, vegetable, or mineral oil, about an equal bulk of a mixture compounded as follows, is incorporated: 42 gallons lime water, 10lb. French chalk, 4oz. ammonium chloride, 4oz. ammonium carbonate, 2oz. potassium carbonate, 2oz. borax, 10lb. sulphur.—W. L. C.

XII.—PAINTS, VARNISHES, AND RESINS.

Improvements in the Manufacture of White Lead, and in Apparatus to be used therefor. E. V. Gardner, London. Eng. Pat. 3839, March 25, 1885. 8d.

THE inventor claims—*Firstly*, the arrangement of the melting pots and heating chamber, described at length in the specification; *secondly*, the use of the higher oxides of nitrogen other than nitric acid, mixed with acetic acid and water, or watery vapour; *thirdly*, a method of supplying the gases and vapours to the converting chamber, by means of a combined "injector-exhaust-evaporator;" *fourthly*, an arrangement of troughs containing water or diluted acid and an electro-negative to lead, and the connection thereof with the lead to be converted, within the converting chamber; and, *fifthly*, the construction of apparatus for drying white lead.—E. G. C.

Anti-fouling and Anti-corrosive Composition for Ships and Submerged Structures. P. Denniston, Glasgow. Eng. Pat. 4415, April 9, 1885. 6d.

THE inventor uses paraffin scale as the base of his anti-fouling composition, and he prefers to employ such a mixture as the following: Paraffin scale, 10 parts; white lead, zinc, or other paint, 7; bronze green, 6; light green, 1; rosin, 2; arsenic, or cyanide, or oxide of mercury, 2.—E. G. C.

Gutta-percha from Bassia (Butyrospermum) Parkii. G. Don, Ed. Heckel and Fr. Schlagdenhauffen. Compt. Rend. 101, 1069—1071.

ACCORDING to the experiments described in the paper, as regards density, solubility, and amount of ash, the above gutta-percha is almost identical with ordinary gutta-percha, but yields on extraction less substance than the latter does, to petroleum spirit, ether, turpentine and boiling acetic acid.—T. L. B.

XIII.—TANNING, LEATHER, GLUE, AND SIZE.

Improvements in Leather, and in the Manufacture or Treating of same. A. Johnson. Eng. Pat. 7818, June 27, 1885. 6d.

LEATHER, tanned by the ordinary process, is coated on the flesh side with a dressing composed of common rosin (3 parts) and tallow (1.25 parts). Japan wax and paraffin oil or Japan, carnauba, paraffin or bees-wax, alone, may be used instead. The hide is then placed in a suitable chamber, kept warm enough to liquefy the dressing. The operation is repeated till the hide has absorbed sufficient dressing. The cooled hide is then placed in a bath of water, maintained at 80° F., till saturated. It is then reset, and when dry is ready for use.—B. H.

The Industrial Utilisation of Leather Waste. J. W. Davies. Eng. Pat. 11,880, October 6, 1885. 6d.

THE leather waste is passed through a suitable disintegrator or devil, the degree of fineness to which it is reduced depending on the size or smoothness of surface to be given to the resulting product. The sieved leather flock is then mixed with a small percentage of glue, gutta-percha, or similar binding material, so as to form a stiff paste, with which other substances are incorporated, according to the class of goods to be made. The final form is given to the articles by pressing or rolling the paste in any well-known way. A number of recipes are given for making boot heels, door knobs, reels, flooring tiles, etc.—B. H.

XIV.—AGRICULTURE, MANURES, Etc.

On the Thomas Slag. Dr. Pieper. Chem. Zeit. 9, 1629.

AT a meeting of the German Society of Manure Manufacturers, held at Berlin, on November 7, 1885, Dr. Pieper gave the results of some experiments made by him with

the Thomas slag. He employed a slag (1) containing 17 per cent. P_2O_5 , and 49 per cent. CaO ; another (2) containing 18 per cent. P_2O_5 , and 47 per cent. CaO ; and a third (3) with 20 per cent. P_2O_5 , and 33 per cent. CaO . Coprolites, containing 18 per cent. P_2O_5 , and a phosphorite, with 25 per cent. P_2O_5 , were also taken, for the purpose of comparison. The results of some experiments as to the solubility of the P_2O_5 present in the five materials are here given:—

	Soluble in Citric Acid.	Soluble in dilute Acetic Acid.	In 1000 parts of carbonated water dissolved in 24 hours.
Slag I.	3.53	58.07	0.9
Slag II.	3.68	51.23	0.91
Slag III.	4.38	36.34	5.54
Coprolites	1.02	10.95	2.55
Phosphorite ...	1.00	5.64	1.71
—E. G. C.			

*On the Action of the Thomas Slag, when used for Manu-
rial Purposes.* F. v. Maltzan. Chem. Zeit. 9, 1827.

AFTER reviewing investigations which have been made in connection with this subject, the author expresses the opinion that the use of the slag is a makeshift, and that the action of this material has not been sufficiently accurately ascertained. Its low price is, of course, in its favour.—E. G. C.

XV.—SUGAR, GUMS, STARCHES, Etc.

Improvements in the Manufacture of Grape Sugar. Oskar Korschelt. From H. Soxhlet, Munich. Eng. Pat. 7098, June 10, 1885. 6d.

THE improved process relates to the preparation from rice starch of a mixture of maltose and dextrine by the action of malt, and then of the conversion of these substances into glucose, by heating the solution with sulphuric acid, under pressure or otherwise. When working under pressure in closed vessels, sulphuric acid is employed in the following proportions, and the duration of the boiling is regulated as follows:—

No.	Sulphuric Anhydride per 100 gallons of liquid.	Atmospheres pressure.	Hours.
1	20½ oz.	2	4½
2	41	1	5
3	41	2	3
4	82	1	4
5	82	2	2
6	120	1	2
7	160	1	1½

The liquor used in above treatment indicates 10 to 13 degrees on the saccharimeter. When the conversion into glucose is completed, the acid is neutralised by carbonate of lime.—A. J. K.

Improvements relating to Filters, and to Apparatus connected therewith, for Purifying Sugar Liquor. W. R. Lake. From F. O. Mathiesen, New York. Eng. Pat. 1888, February 9, 1886. 8d.

Improvements in Filtering Apparatus for Use in the Purification of Sugar. W. R. Lake. From R. C. Howes, New Jersey, U.S.A. Eng. Pat. 1891, February 9, 1886. 6d.

Improvements in Filtering Apparatus for Purifying Sugar Liquor. W. R. Lake. From E. E. Quindry, New Jersey, U.S.A. Eng. Pat. 1890, February 9, 1886. 8d.

Improvements in and relating to Dischargers for Filtering Apparatus to be used in the Purification of Sugar Liquor. W. R. Lake. From F. O. Mathiesen, New York, U.S.A. Eng. Pat. 1889, February 9, 1886. 8d.

THE above four patents relate to the continuous process of upward filtration of sugar liquor through bone charcoal,

and have special reference to various devices for removing the spent char from the bottom of the char cisterns, either by revolving bottoms or by rocking grates.

—A. J. K.

Improvements in or connected with Triple Effect Evaporating Apparatus, used in the Manufacture of Sugar, and similar Vacuum Apparatus. J. McClure C. Paton, Nottingham. Eng. Pat. 1844, February 10, 1886. 6d.

THE above invention relates to a new way of removing the water of condensation collecting on the lower tube plate, or at the bottom of the calandria or heating drum, of the second and third pans, in a triple effect arrangement.—A. J. K.

Improvements in the Manufacture of Starch, and in Apparatus employed therein. B. H. Remmers. From L. von. Wagner and A. Gillitzer, Buda-Pesth. Eng. Pat. 4758, April 17, 1886. 11d.

THE improved process consists in subjecting maize, rice, or other grain to the following treatment:—(1) Seaking in a weak solution of sulphurous acid; (2) uniformly crushing the softened grain by means of rollers, as set forth; (3) drying and pulverising the grain by means of a disintegrator; (4) soaking the flour so produced in a solution of sulphurous acid; (5) removing the bran, germs and coarser particles from the starch milk by strainers; (6) separating the water and gluten from the starch by centrifugal or other means. The authors also claim improvements in feeding hoppers and other machinery used in above process.—A. J. K.

A Method or Process for the Extraction of Sugar from Saccharine Juices, Syrups and Molasses. Louis Le Franc, of Tracy-le-Val, France. Eng. Pat. 6358, May 23, 1886. 6d.

THE above patent consists of a combination of two known processes for the recovery of sugar from saccharine solutions. In the first process, the liquor, which should contain not less than from 5 to 12 per cent. sugar, is treated first of all with lime in the cold, and then boiled, when the following reaction takes place:— $3(C_{12}H_{22}O_{11} \cdot 2CaO) + 2(C_{12}H_{22}O_{11} \cdot 3CaO) + C_{12}H_{22}O_{11}$. The dilute filtrate from the insoluble tribasic sacrate is then treated in the cold with lime, calcium chloride, and caustic soda, when the remaining sugar is precipitated as insoluble tribasic sacrate, according to the following equation:— $3(C_{12}H_{22}O_{11} \cdot 2CaO) + CaCl_2 + Na_2O = 3(C_{12}H_{22}O_{11} \cdot 3CaO) + 2NaCl$.—A. J. K.

Improvements in Treating Sugar and Like Substances, and in Apparatus therefor. G. M. Newhall and J. H. Tucker, Philadelphia. Eng. Pat. 8843, July 22, 1886. 8d.

INSTEAD of machining raw sugar in the ordinary way, by washing the sugar by hot or cold water in the centrifugal machines, the authors prefer to use a solution made by dissolving a portion of the raw sugar in hot water. About 30 parts of this liquor (36 B.) are added, at a temperature of 200° F., to 100 parts raw sugar, at a temperature of say 60° F. The whole mass is thoroughly mixed in a heater, and then transferred to the centrifugal, when it is machined. By the ordinary process it is impossible to machine, to any advantage, fine-grained sugars especially such sugars as Brazilian, Manillas, etc., which are, in addition, of a gummy nature. By the new process, however, these sugars may be melted and used as a liquor for machining coarser-grained raw sugars.—A. J. K.

XVI.—BREWING, WINES, SPIRITS, Etc.

On the Causes of the Formation of Bad Crude Spirit in Uninterrupted Distillation. Dr. R. Rempel. Chem. Zeit. 9, 1692.

THE author begins his communication by referring to F. Pampé's investigations on this subject (Chem.

Zeit. 9, 1374, 1410, and 1467). Pampe names three causes of the formation of bad spirit: 1. Contamination of the spirit by sulphuretted hydrogen and hydrocarbons, produced by the action of the acids of the mash upon the inner surfaces of iron distillation apparatus; 2. Formation of hydrogen sulphide in consequence of the decomposition of albuminous substances; 3. Production of fusel oil during the operation. The author in the main corroborates Pampe's statements, but dissents from them in certain particulars.—E. G. C.

A New and Useful Process for Preventing from any Possible Alterations the Saccharification of Amylaceous Substances by Malt. Léon Ensinier, Paris, France. Eng. Pat. 7788, June 26, 1885. 6d.

THIS is the application of the well-known fact that chloroform, ether, and anesthetics in general do not affect the action of the soluble ferments, whilst they prevent entirely the growth and action of micro-organisms. The inventor adds 0.01 per cent. of the anæsthetic, preferably chloroform, to the wort; this preserves it for an indefinite time, without retarding the saccharification. The chloroform can be got rid of by boiling. If the process of saccharification is carried on in closed vessels, no loss of chloroform takes place by volatilisation, and the whole can be recovered by distillation.—G. H. M.

Improvements in the Processes of Distilling and Rectification. J. Wright, London. Eng. Pat. 2604. February 23, 1886. 4d.

THESE improvements consist in the employment of a partial vacuum in the still during the distillation, and a consequent lower temperature than would be employed in the usual way. A steam jacket or steam coil is preferred as the source of heat.—G. H. M.

XVIII.—ELECTRO-CHEMISTRY.

Improvements in Coating Copper Printing Plates to render them more durable. H. M. Senhouse, Stoke-upon-Trent. Eng. Pat. 5977, May 15, 1885. 6d.

A COAT of iron is first deposited upon the copper, and then a coat of nickel upon the iron, thereby making the plates more durable, and rendering more easy the removal of the nickel from the copper when partly worn.—W. B.

Improvements in the Continuous Manufacture of Light Metals by Application of Electrolysis, and in Apparatus therefor. P. Jensen. Eng. Pat. 7510, June 19, 1885. 8d.

IN order to produce the light metals on a cheap scale by electrolysis, the author proposes an arrangement of a number of half retorts or bottomless retorts, placed horizontally in a furnace, connected with suitable receivers. The light metals formed in the half retorts, from the halogen compounds with which they were charged, are withdrawn, without interrupting the electric current, and allowed to cool with the air excluded.

—W. B.

Improvements in Electrical Batteries. H. C. B. Chalders and A. J. Thorman, London. Eng. Pat. 7733, June 25, 1885. 4d.

SEAWEED or sea-wrack is used as an exciting agent in primary or secondary batteries.—W. B.

An Improved Carbon Element for Galvanic Batteries. C. R. Goodwin, Paris. Eng. Pat. 8331, July 9, 1885. 8d.

CARBON elements of galvanic batteries, when being moulded, have a metallic screw-threaded rod partly embedded in them, after which they are baked. The conducting wire is held between a washer and nut, which are screwed upon that part of the rod not embedded.

—W. B.

Method of Constructing Electrode Frames for Secondary Voltaic Batteries. A. Khotinsky, Rotterdam. Eng. Pat. 8416, July 11, 1885. 6d.

ELECTRODE frames for secondary batteries are formed with recesses, having ribs or partitions separating them, with inwardly projecting lips or flanges, the electrode material being placed in the recesses.—W. B.

Improvements in Galvanic Batteries. A. R. Upward, and C. W. Pridham, London. Eng. Pat. 9302, August 4, 1885. 8d.

THIS invention relates to batteries which are maintained in an active condition by the passage of chlorine gas through the cells. The gas is caused to be delivered from the generator into the lower part of a high column of vertical pipes open at the top and connected near the bottom by a tube, with the batteries to be supplied. An aspirator, in which a jet of water operates to propel the air, is provided at the outlet of each battery. An electric governor controls the water supply to the aspirator in accordance with the current delivered by the battery.

—W. B.

An Improved Voltaic Battery. S. W. Maquay, London. Eng. Pat. 15,040, December 8, 1885. 8d.

THE chief improvement is in constructing the positive elements used with the battery, of an alloy consisting of zinc, 95 parts; lead, 2 parts; tin, 2 parts; and mercury, 1 part. This alloy having been cast into the desired shape, it is alternately amalgamated, and then heated to 100° F., until it has taken up a very considerable quantity of mercury. Any convenient negative element, such as carbon or platinum, may be used, after it has been dipped into liquid sulphur.—W. B.

Improvements in Smelting Ores by means of Electricity, and in Apparatus or Furnaces therefor. A. H. Cowles, U.S.A. Eng. Pat. 1160, January 26, 1886. 8d.

THE charge to be reduced is contained in a furnace-chamber having electrodes fitted into its opposite sides. The electrodes which are buried in the charge are drawn further apart, according as the resistance diminishes during the reduction of the charge, either by hand, clockwork, or automatically by the current in the circuit. As the heated portions of the electrodes emerge slowly from the furnace, they first pass through copper boxes containing small copper shot, by means of which they are reduced to such a temperature that they are not injured on being exposed to the air.—W. B.

XIX.—PAPER, PASTEBOARD, Etc.

Improved Process for Preparing Paper for Indelible Writing. D. S. Simpson, Edinburgh. Eng. Pat. 3980, March 28, 1885. 4d.

PAPER, cardboard, wood or other material on which writing or printing can be done is impregnated with certain chemicals as follows:—Carbonate of soda or potash, cyanides or any soluble salts having the desired effect of rendering the ink or other writing, printing, or marking material indelible to water. Inventor finds the following salts suitable for his purpose:—Sodium carbonate, or bicarbonate, the corresponding potassium salts, potassium ferrocyanide, with or without the addition of a mordant like alum or tin chloride. Either of these mordants may also be used alone.—H. A. R.

Improvements in Sizing Paper and such-like Material. C. Weygang, London. Eng. Pat. 5585, May 6, 1885. 6d.

THE object of these improvements is the sizing of paper with certain substances of an oily, fatty, resinous, or tarry nature in such a manner as to produce a stronger and more impermeable material than is ordinarily obtained. Any oils, resins, or tar, or any allied substances soluble in alkaline solutions, may be employed. The

mixtures proposed, which inventor terms "size," are incorporated in the beating engine in the usual way. The size is precipitated by an alkaline salt—*e.g.*, nitrate or sulphate of ammonia, either alone or together, with other more energetic precipitating agents, such as an acid, an acid salt, a calcium salt, a salt of chromium in conjunction with another metallic salt. Sometimes the ammonia salt is omitted altogether, and a salt of chromium or manganese is used in combination with another metallic salt, such as sulphate of iron, aluminium, copper or zinc. The following are examples of the kind of mixtures it is proposed to use along with common rosin size such as usually employed by paper-makers.

Rosin	30 parts.
Soap	30 "
Petroleum or Turpentine	10 "
Wood Tar	80 "
Ordinary Soap	20-40 "
Rosin	20-40 "
Crude Carbolic Acid	15-20 "

A great variety of mixings is given, also different modes of applying the same to produce different effects.

—H. A. R.

Improvements in the Preparation of Paper Pulp from Straw, Esparto, Wood, Rags, and like Fibrous Substances. R. C. Menzies, C. F. Cross, and E. J. Bevan, London. Eng. Pat. 6839, June 5, 1885. 4d.

THIS invention consists essentially in subjecting the substances, after they have been pulped and before they have been bleached, to the action of chlorine gas and an alkali or alkaline salt.—H. A. R.

Improvements in Machines for Cleansing Esparto and other Grass used in Making Paper. G. Petrie and F. W. Petrie, Rochdale. Eng. Pat. 7772, June 26, 1885. 11d.

THE main points in this invention are the following:—1. The construction of the beater fan, which is armed with studs or teeth, or with plates or blades. 2. The combination of the same with a dead plate armed with teeth and with one or more grids underneath, and in combination with an exhaust fan.—H. A. R.

Improvements in Apparatus for the Manufacture of Paper. C. J. Richardson. Eng. Pat. 10,543, September 5, 1885. 8d.

THE object of this invention is to afford increased facility for making changes in the width of paper during manufacture without having to stop the machine. The deckle frames are made to move in or out simultaneously under the manipulation of a single man without any stoppage of the paper machine, whilst the action of the same mechanical means rolls up or spreads out the apron as required.—H. A. R.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

Observations and Experiments on Poisoning by Atropine. Chem. Centr. 17, 217.

EXAMINATION of the urine is particularly important, as atropine is entirely absorbed and passes away unchanged with the urine. Although a microscopical examination in polarised light cannot by any means give sufficient evidence for deciding on the presence of atropine, it is nevertheless of interest, as the sulphate crystallises in a characteristic way, and any foreign matter may thus be detected with absolute certainty. It is only by a positive result of a physiological experiment that we are justified in looking upon the presence of atropine as beyond any doubt. The human eye is best adapted for such an investigation owing to its great sensitiveness. Atropine exhibits a striking resistance to decay, and may probably be detected in a corpse, even if months have elapsed since death.—A. R.

Some New Drugs. Chem. Zeit. 10, 433.

ALMOST all parts of the plant *Anona muricata* L. have a medicinal value. Thus a decoction of the root is used as an antidote for fish-poisoning, and the bark serves as an astringent. The leaves are useful in softening abscesses, and as the seeds in the fruit contain tannin, the latter are employed as astringents, or a wine can be prepared from them by fermentation, which is said to be beneficial in cases of diarrhoea.

Several kinds of *anona*, such as *polyalthia*, *xylopia*, *artobotrys*, are also highly prized as medicines. Most of these plants have a sharp aromatic odour and taste. The flavour of the fruit resembles that of oil of turpentine.

Eupatorium.—Many kinds of this species have an aromatic odour and bitter taste, the latter being so intense that *E. amarissimum* is used in Mexico, and *E. villosum* sweet in Jamaica as a substitute for hops. *E. ayupama* is a good remedy for indigestion, and an infusion of it is said to give relief to patients suffering from chest complaints, and has been employed on the Isle of France as an antidote for cholera.—A. R.

Properties of some New Drugs. The Pharmacopœia Commission of the German Chemists' Union. Arch. Pharm. 24, 166.

BESIDES a thorough investigation into the contents of the pharmacopœia, the above commission intend to examine all new medicinal preparations, and of these the following have been recently studied:—

Ammonium ichthyolsulphonate is a thick, clear syrup of a redish-brown colour. It is soluble in water and in a mixture of equal volumes of ether and alcohol. On adding hydrochloric acid to the aqueous solution, a resinous mass is precipitated.

Arbutin.—An aqueous solution is coloured green by small quantities of a solution of ferric chloride, and blue by a larger amount of that reagent. On heating with 1 part of water, 2 parts of sulphuric acid, and 8 parts of manganese dioxide, a penetrating odour of quinone should be observed.

Thallium sulphuricum is a yellowish-white crystalline powder, resembling cammarin in its odour. A dilute solution (1:100) is coloured a deep green by ferric chloride, changing to a dark red after a few hours.

—A. R.

The Artificial Production of Codeia. G. B. Dott. Eng. Pat. 7413, 1885. 6d.

THE patentee produces codeia artificially by the action of methyl chloride, preferably under pressure, upon morphia.—T.

The Preparation of a Colourless or Decolourised Solution of Iodine. H. N. Draper. Eng. Pat. 7527, June 20, 1885. 4d.

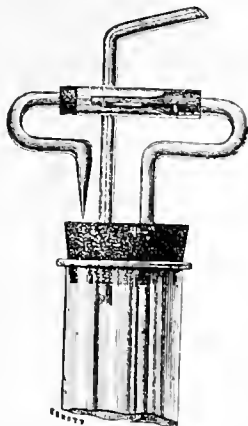
THE patentee affects his object by forming combinations of iodine with orcin, phoroglucin, resorcin and similar organic bodies, which are so loose as that, upon evaporation of the solution, the iodine is left in a free or uncombined state.—T.

XXII.—GENERAL ANALYTICAL CHEMISTRY.

Wash-bottle for Quantitative Work. M. Wernecke. Chem. Zeit. 10, 399.

To prevent the water from receding in the exit tube of the wash-bottle, the author constructs it in the following manner:—The exit tube being bent in the shape of a U, the upper limb is cut off short, and a piece of india-rubber tubing attached, closed at the end by a glass rod, and also provided with one of Bunsen's slit valves. Over the india-rubber tubing a piece of glass tubing of

somewhat wider dimensions is passed, and attached to the free end of this by means of an indiarubber ring is



the glass tubing, bent and drawn out to a point as shown in the figure.—A. R.

Determination of Carbon and Hydrogen by means of Copper Oxide Asbestos. E. Lippmann and F. Fleissner. *Monatsh. Chem.* 7, 9.

To prepare molecular copper, a solution of a copper salt is treated with ammonia, then with a sufficient quantity of caustic soda to redissolve the precipitate, and boiled ten minutes with a solution of grape sugar. Thus cuprous oxide is formed, and can be further reduced to metal. The precipitate of this, after decanting the solution, is washed with dilute sulphuric acid to remove any cuprous oxide. The metal is lastly washed with water. Another method is to reduce with zinc dust and to remove excess of the latter by boiling with sulphuric acid. The spongy mass obtained in this manner must be dried and powdered. By shaking 20–30 grms. of the powder, which has been dried over sulphuric acid with some silky asbestos, the copper is made to adhere to the fibre. The combustion tube should be about 70cm. in length and 1.5–2cm. wide. A stopper of silver gauze is inserted at *a* (Fig. 1), then follows a layer of 20cm. of

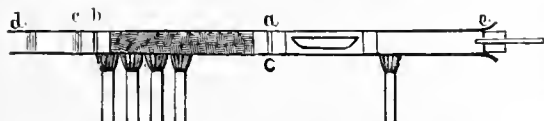


FIG. 1.

copper-asbestos, another stopper at *b*, similar to the one at *a*, and adjoining the latter a stopper of asbestos. The part *a b* being heated to a dull-red heat, a dry current of air is slowly passed through the tube, and when nearly all the copper has been oxidised, the current of air is replaced by one of oxygen, until this gas is detected at *d*. After cooling, the tube is filled from *c* to *d* with a layer of lead oxide 5cm. in length, previously boiled with nitric acid, an asbestos stopper being inserted at *d*.

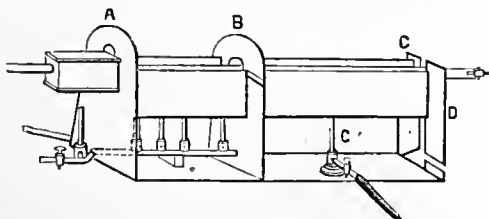


FIG. 2.

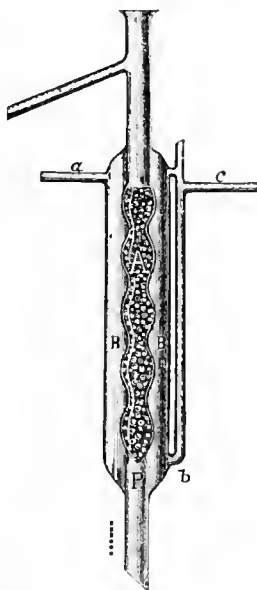
The authors recommend Kopfer's combustion furnace, with slight alterations (Fig. 2). The front part of the

tube is first heated to a red heat, then the lead oxide to 150–200°, and when sufficient oxygen has been passed through the tube, the boat containing the substance is quickly introduced, a spiral of copper gauze being placed immediately behind it. The latter is now heated with burner *c* and the application of heat gradually extended to the whole tube. Finally, the part where the substance originally was is strongly heated. Solid bodies must be covered in the boat with lead chromate, and cyanogen compounds should previously be well mixed in an agate mortar with one part of potassium chromate and ten parts of lead chromate.

A combustion by this method only takes 1½ hours, even if the body analysed contains a high percentage of carbon. The authors give the results of numerous analyses proving the exactness and the wide range of their method, which they expect will soon be in general use in laboratories, where it is sure to be preferred to any other.—A. R.

Tube for Fractional Distillation. Rud. Rempel. *Chem. Zeit.* 10, 371.

THE author claims that these tubes combine the advantages of those constructed by Linnemann and Hempel on the one hand, and by Winssinger on the other hand—*i.e.*, it serves the purpose of rectification and dephlegmation at the same time. The part A of the tube is filled with glass beads, and the vapour which passes through is partly condensed by means of a fluid which enters B by *a* and is conducted away through *c*. At the same time the condensed vapour, in passing over the glass beads, is rectified again by the rising vapour. It is obvious, from the direction in which the fluid passes through B, that the layers in the lower portion of B are warmer than those in the higher, and a much better separation of the constituents of the vapour is thus effected. This tube is specially adapted for mixtures boiling below 100°, for in that case the water from the condenser may be used for dephlegmation. To effect this, the exit tube of the condenser is connected with *a*, and by increasing or decreasing the supply of water to the condenser, the temperature of the water, which passes into the dephlegmator, can be regulated at will. A certain size of the glass beads is essential to the good working of the apparatus. For fluids which are very



mobile the beads should be 4–5mm. in diameter, whereas in the case of oily fluids which boil with difficulty, the diameter should be 6–7mm. and more. The platinum net *p* must have wide meshes. The author finds the apparatus most serviceable in separating the various constituents of fusel oil.—A. R.

Drying Apparatus. V. Meyer. Ber. 19, 419—420.

This paper is a supplement to a former article (this Journal, 1886, p. 106), in which a drying and heating apparatus devised by the author was described. Attention is called to the necessity of employing perfectly pure heating agents, as mixtures of liquids differing in boiling points indicate temperatures varying with the size of the flame employed.—D. E.

Analysis of Cyanogen Products from Blast Furnaces. H. V. Jüptner. Chem. Zeit. 9, 1805.

THE mass is treated with water and filtered. A part of the filtrate is evaporated to dryness after digestion with aqua regia, and used for the determination of SiO_2 , K_2O , Na_2O , and S. To a second portion of the aqueous solution is added barium acetate, which throws down SiO_2 and CO_2 ; these are determined as usual. To the filtrate is added in excess a measured quantity of AgNO_3 solution. The amount of excess of silver solution is determined. The precipitate is now treated with HNO_3 , which dissolves silver cyanate. The silver in this solution is titrated, and the cyanic acid thus estimated. The residue is dried, ignited, and treated with ammonia. AgCl goes into solution, from which it can be again precipitated by HNO_3 , then weighed as usual.

—E. G. C.

Quantitative Analysis by means of Electrolysis. Alex. Classen and Robert Ludwig. Ber. 19, 323—327.

IN a previous communication (Ber. 14, 1630) it was stated that arsenic could not be deposited by electrolysis either from an aqueous solution or from one containing hydrochloric acid or ammonium oxalate. It has not been found possible, on the other hand, to obtain a deposit of antimony free from arsenic (Ber. 18, 1110). The authors now find that the separation may readily be effected if the arsenic is in the form of arsenic acid or a corresponding compound. The mixture of antimony and arsenic or of their compounds is evaporated to dryness with aqua regia, dissolved in 2 or 3 cc. of water, and treated with concentrated caustic soda until about a gram of NaOH is contained in the solution. About 60 cc. of sodium sulphide solution (Ber. 18, 1110) are added, and the elements separated in the same way as antimony and tin (*loc. cit.*). The arsenic is estimated as usual in the residual solution.

Antimony may be separated from arsenic and tin by the above method, but if the latter elements are also to be estimated, the modified method of Fischer and Hufschmidt, described in the paper referred to, is to be adopted.

Mercury may be deposited from a solution slightly acidified with nitric acid, if the experiment is continued for twelve to sixteen hours at the ordinary temperature by such a feeble current as would liberate 0.5 to 1.0 cc. of oxygen and hydrogen in that time. It is possible to separate mercury in such a solution from the alkaline earths, from chromium and aluminium, from nickel and cobalt, from iron, manganese and uranium, and from cadmium. 2 cc. of concentrated nitric acid are added to about 200 cc. of solution. The mercury is washed with cold water while the current still passes, then with alcohol, and it is dried over sulphuric acid. Mercury could not be separated from bismuth by this method.

The difficulty hitherto experienced in obtaining a coherent deposit of bismuth (Ber. 14, 1626) has been overcome by Herr Eliasberg in the following manner: The bismuth salt is treated in a weighed platinum basin with 10 cc. of potassium oxalate solution (1:3), and to the warmed mixture solid ammonium oxalate is added until the whole is dissolved. The solution is diluted to 150 cc., and a current is passed, at a temperature of 70 to 80°, of an intensity barely sufficient to decompose water. Two Meidinger's elements, with an external resistance of about 60 Ohms., are recommended. After about sixteen hours the solution is acidified with pure oxalic acid and the electrolysis continued. After twenty-four hours a drop of the solution is tested for bismuth with sulphurated hydrogen. When the deposition is complete the

current is stopped and the metal washed with water. In case of partial oxidation of the bismuth it is advisable to dissolve it in nitric acid, and estimate it as oxide. Bismuth was separated from zinc, nickel, cobalt and uranium by this process, but it was not found possible to separate it from iron. Details of numerous analyses are given in this paper.—S. Y.

On the Employment of Hydrogen Peroxide in Volumetric Analyses. S. Eliasberg. Ber. 19, 320—323.

THE method proposed by Classen and Bauer (Ber. 16, 1061) for the estimation of sulphur in sulphides by oxidation to sulphuric acid by means of hydrogen peroxide is a gravimetric process requiring hydrogen peroxide free from H_2SO_4 , which is difficult to obtain.

The author performs the oxidation with carefully neutralised hydrogen peroxide to which a measured volume of standard alkali has been added. The excess of alkali, left uncombined with the H_2SO_4 , is then titrated back with standard acid, using dimethylaniline-orange as an indicator. In the case of sulphides which evolve H_2S on treatment with acids, the determination is made in the apparatus used by Classen (Ber. 16, 1069), the H_2S being passed into the peroxide solution and the analysis completed as above. Thiosulphates (and other poly-thionic acids) are gently heated with the alkaline hydrogen peroxide solution for half-an-hour, and the excess of alkali then titrated back. The quantity of H_2SO_4 found multiplied by the factor 2.5316 gives the quantity of $\text{Na}_2\text{S}_2\text{O}_3 + 5\text{H}_2\text{O}$ which was present. The process is very simple, and the results are fairly accurate.

—A. G. G.

Bacterioscopic Examination of Water. Dr. Link. Arch. Pharm. 24, 145.

IN an article by Professor Koch on the above subject, the following passages occur:—" . . . the presence of numerous micro-organisms denotes that this water is in a state of decomposition." "As far as we can judge at present, the number of micro-organisms in 1 cc. of good water varies between 10 and 150 germs, capable of development. When the number considerably exceeds these figures, the water must be looked upon as suspicious. If there are 1000 and more germs in 1 cc., such water should be declared unfit for drinking." The author claims to have arrived at results entirely at variance with Koch's statements. A considerable number of micro-organisms were discovered in numerous samples of well-water, which could not possibly have been contaminated in any way. Moreover, these waters would have been declared good if judged by the results of a chemical analysis. On the other hand water, which after a chemical analysis would have been considered unfit for drinking, and which was, as a matter of fact, polluted with sewage matter, was sometimes remarkably free from bacteria that had reached development. Numerous reasons are also adduced showing that the dangerous germs could not, as a general rule, be maintained, still less propagated in such water. In summing up, the author thinks no stress can be laid on the results of a bacterioscopic examination of water, which is based on a determination of the number of micro-organisms capable of development and contained in that water. The conclusions which might be drawn from such an examination are, in fact, generally the very reverse of those arrived at by the aid of an analysis, and the latter must, at present, be considered the only criterion in judging of the purity of a specimen of water.—A. R.

Detection of Sulphonated Magentas and Ordinary Magentas by means of Metallic Oxides. P. Cazeneuve. Bull. Soc. Chem. 45, 233.

ON shaking 10 cc. of wine with 0.2 gm. of yellow mercuric oxide, the former is entirely decolourised if natural, while acid magenta is not precipitated, and 0.0001 gm. of the latter in 10 cc. of wine may thus be readily detected. The ordinary magentas are only partially pre-

precipitated, and mercuric oxide is therefore no very delicate test for these colours.

When wine is shaken up with moist lead hydroxide for a few minutes, the normal colouring matter is entirely absorbed by it. 2grm. of the hydrate containing about 50 per cent. of water should be taken for 10ccm. of wine. Acid magenta is partly absorbed but not so the other magentas, and of these the author was able to detect 0.00001grm. in 10ccm. of wine. Moist stannic hydrate is a good reagent both for acid magenta and for ordinary magentas, whereas gelatinous ferric hydroxide cannot be recommended at all.—A. R.

Reactions for the Identification of certain Narcotic Extracts. C. Leuken. Pharm. Zeit. **31**, 105.

As it is difficult to obtain fresh material for the preparation of narcotic extracts, many druggists are compelled to buy them, and it is, therefore, very important to have some trustworthy reactions for their identification.

After acidifying the solution of the extract with hydrochloric acid, potassium mercuric iodide ("Mayer's reagent") is added, the well-washed precipitate suspended in water and treated with alkali. The mixture is then extracted with a suitable solvent, and on evaporating the latter, the alkaloid remains in a sufficiently pure state to make identification possible.

Extr. Aconiti.—A few grams are treated as above described and the precipitate suspended in water and mixed with a few drops of ammonia. After extracting with light petroleum and evaporating the latter, the residue is heated on the water-bath with phosphoric acid, in which a few pieces of glacial phosphoric acid have been previously dissolved; after a short time the mass assumes a distinct violet colour.

Extr. Belladonna treated as above, but extracted with ether, gives Vitali's atropine reaction perfectly. If the residue from the ethereal extract be mixed with a few drops of nitric acid, then heated on the water-bath, and finally mixed with a few drops of a solution of caustic potash in absolute alcohol, a beautiful violet colour is produced.

Extr. Hyoscyami reacts similarly to *extr. belladonna*, but precipitation with "Mayer's reagent" is not so complete, and the colour consequently less intense. To distinguish between the two extracts, the residue obtained by evaporation of the aqueous solution, to which some ammonia has been added, is best examined under the microscope. The crystals of *extr. belladonna* are feathery, whereas in the case of *extr. hyoscyami* the appearance is that of two crystals lying crosswise one over another.

Extr. Digitalis is not precipitated by "Mayer's solution," but may be recognised by dissolving 1grm. in water and precipitating completely with lead acetate. The filtrate is then extracted with chloroform, and the residue remaining on evaporation of the latter gives a red colour on heating with concentrated sulphuric acid.

—A. R.

A Reaction for Cocaine. T. Biel. Pharm. Zeit. **31**, 132. 0.03GRM. of cocaine is dissolved in 1ccm. of concentrated sulphuric acid, heated on the water-bath for 1–2 min. and allowed to cool. On diluting, crystals of benzoic acid appear after some time.—A. R.

Potassium Permanganate as a Test for Cocaine. F. Giesel. Pharm. Zeit. **31**, 132.

ON adding the requisite amount of a solution of potassium permanganate to a solution of pure cocaine hydrochloride a light violet precipitate of cocaine permanganate is formed. If the solution is very dilute, precipitation only ensues after some time, but the deposit then consists of small brilliant crystals of a dark violet colour. This reaction is not very distinct with commercial cocaine, as the impurities contained in it often discolour the solution or the precipitate. It sometimes happens that cocaine permanganate is not deposited at all. In such cases manganese dioxide is precipitated, and on

boiling the solution smells intensely of oil of bitter almonds, these two reactions being a sure sign of the impurity of the cocaine employed.

To test on a small scale, 0.01grm. of cocaine dissolved in two drops of water are mixed with 1ccm. of a solution containing 0.3grm. of potassium permanganate, when a violet precipitate must be formed, and no odour of oil of bitter almonds should be noticeable on boiling.

—A. R.

Quantitative Determination of Methoxyl (OCH₃). S. Zeisel. Monatsh. f. Chem. **6**, 989–996.

THE method consists in heating the compound with hydriodic acid (of sp. gr. 1.68, prepared by phosphorus) and receiving the methyl iodide formed in an alcoholic solution of silver nitrate. From the weight of silver iodide produced the percentage of methoxyl can be calculated, since 1AgI corresponds to 1CH₃O. The substance (0.2–0.3grm.) is boiled in a small flask with 10cc. of aqueous hydriodic acid (sp. gr. 1.68), whilst CO₂ is passed slowly through the liquid; the gases are led through an inverted condenser surrounded with water at 40–50° C., and through a Geissler's bulb apparatus, also kept warm, containing red phosphorus (½–¾grm.) suspended in water, to retain iodine vapours and HI. The methyl iodide is finally absorbed in two flasks, each containing 25–50cc. of the alcoholic silver solution. The precipitated silver iodide is separated and weighed. The analyses given are very satisfactory.—A. G. G.

New Books.

WATTS' MANUAL OF CHEMISTRY: THEORETICAL AND PRACTICAL (Based on Fownes' Manual). Vol. II.: Chemistry of Carbon-Compounds; or, Organic Chemistry. Second Edition (Thirteenth Edition of Fownes). By WILLIAM A. TILDEN, D.Sc., F.R.S., V.P.C.S., Professor of Chemistry in the Mason College, Birmingham. London: J. & A. Churchill, 11, New Burlington Street, 1886.

8vo volume, bound in cloth, containing 646 pages of subject-matter, and Appendix with Tables of the Strength of Spirits of different specific gravities, and some additional matter devoted to Lævulose and Anthracene. The pages are illustrated with some 20 woodcuts, and numerous useful tables are given. The nomenclature has throughout been brought into conformity, as Professor Tilden remarks in his Preface, with the system recognised and adopted by the Chemical Society of London. The arrangement of the matter of this useful work is disclosed in a review of the Table of Contents, the chief headings in which are given as follows:—INTRODUCTION. ELEMENTARY OR ULTIMATE ANALYSIS OF ORGANIC COMPOUNDS. CLASSIFICATION OF ORGANIC COMPOUNDS. ORGANIC SERIES. PHYSICAL PROPERTIES OF ORGANIC COMPOUNDS. DECOMPOSITIONS AND TRANSFORMATIONS OF ORGANIC COMPOUNDS. METHANE DERIVATIVES OR FATTY GROUP. MONOHYDRIC ALCOHOLS AND ETHERS. DIHYDRIC ALCOHOLS AND ETHERS. TRIHYDRIC ALCOHOLS AND ETHERS. TETRAHYDRIC ALCOHOLS AND ETHERS. HEXHYDRIC ALCOHOLS AND ETHERS. AMINES. MONAMINES. DIAMINES. TRIAMINES. PHOSPHORUS, ARSENIC AND ANTIMONY-BASES, ORGANO-BORON COMPOUNDS, ETC., ALDEHYDES. KETONES. CARBOXYLIC ACIDS. AMIDES. BENZENE DERIVATIVES OR AROMATIC GROUP. INDIGO GROUP. DIPHENYL GROUP. NAPHTHALENE GROUP. PHENANTHRENE AND ANTHRACENE GROUP. CAMPHENES AND CAMPHORS. RESINS AND BALSAMS. GLUCOSIDES. BITTER PRINCIPLES. COLOURING MATTERS. ALKALOIDS. PECTORAL SUBSTANCES. BILE CONSTITUENTS. GELATINOUS SUB-

STANCES. PROTEIDS OR ALBUMENOID. SUBSTANCES RELATED TO THE PROTEIDS. BRAIN CONSTITUENTS. The work is terminated by a copious Alphabetical Index.

WATER ANALYSIS: A Practical Treatise on the Examination of Potable Water. By J. ALFRED WANKLYN and ERNEST THEOPHILON CHAPMAN. Sixth Edition, by J. ALFRED WANKLYN, M.R.C.S., etc., etc. London: Trübner & Co., Ludgate Hill, 1884.

In this, the Sixth Edition, an addition on page 58 is made, and an extra chapter entitled "Verifications" is all that distinguishes this from the last edition. This book now comprises an Introduction, 154 pages of subject-matter and an Appendix, and terminates with an Alphabetical Index. The pages are illustrated with some four or five woodcuts, and the chapters are headed as follows: Part I.:—I. Collection of Samples of Water. II. Total Solid Residue. III. Chlorine. IV. Organic Matter, "Free and Albumenoid Ammonia." V. The Moist Combustion Process. VI. Poisonous Metals. VII. The Drawing up of Reports. VIII. Verification. PART II.:—SPECIAL ANALYSIS.—I. The Specific Gravity of Natural Water. II. The Water Residue; The Insoluble Solids; The Soluble Solids; The Degree of Alkalinity. III. Hardness. IV. General Quantitative Analysis of the Water Residue; Statement of Results. V. Gases and Vapours Dissolved by Water. VI. Purification of Water. VII. Urine and Sewage. PART III.: EXAMPLES OF COMPLETE MINERAL ANALYSES.—Water Supply to London and to Manchester, etc.

MILK-ANALYSIS: A Practical Treatise on the Examination of Milk and its Derivatives, Cream, Butter, and Cheese. By J. ALFRED WANKLYN, M.R.C.S., etc. Second edition. London: Trübner & Co., Ludgate Hill, 1886.

This is a small 8vo. volume, bound in cloth, and of similar appearance to the "Water Analysis." It contains seventy-six pages of subject matter, some three or four wood-cut illustrations and a table of contents. The subdivision of the matter is as follows:—I. Introductory—Milk, its Nature and Chemical Composition; Description of each of its Constituents; Constancy of its Composition. II. Instruments and Methods for Testing Milk; Outline of Method of Milk Analysis. III. Milk Solids. IV. The Fat. V. Caseine. VI. Milk-Sugar. VII. Ash. VIII. Calculation and Statement of Results. IX. The Milk Supply of the London Workhouses. X. Cream. XI. Butter. XII. Cheese. XIII. Koumiss. XIV. Condensed and Preserved Milk. XV. Poisonous Milk and Milk-Panics.

TEA, COFFEE AND COCOA: A Practical Treatise on the Analysis of Tea, Coffee, Cocoa, Chocolate, Maté (Paraguay Tea), etc. By J. ALFRED WANKLYN, M.R.C.S., etc. London: Trübner & Co., Ludgate Hill, 1874.

This little volume is bound similarly to the preceding works. The subdivision of the text is as follows:—Part I.: Introduction. II. The Ash. III. The Extract, and the Tea-assay. IV. "Free and Albuminoid" Ammonia in Tea-extract; Estimation of Nitrogen in Tea. V. Theine. VI. Tannin in Tea. VII. Calculation of Results. Part II.: Coffee. Part III.: Cocoa and Chocolate. Part IV.: Maté or Paraguay Tea.

BREAD ANALYSIS: A Practical Treatise on the Examination of Flour and Bread. By J. ALFRED WANKLYN and W. J. COOPER. London: Trübner & Co., Ludgate Hill, 1886.

A book similar in appearance and style to the preceding, and containing 72 pages of subject-matter, a Table of Contents, and an Alphabetical Index. The manner of subdivision of the matter into chapters is indicated by the following headings:—I. FLOUR. Its Composition; Description of its Constituents. BREAD: II. The Water in Bread. III. The Ash of Flour and Bread; Mineral Adulteration of Flour and Bread; Alum. IV. The Gluten Assay; The Nitrogenous Portion of Flour; The Yield of Albumenoid Ammonia. V. The Cold Aqueous Extract; Sound and Unsound Flour. VI. On Food. VII. On Corn Flour.

ANALYTISCHE CHEMIE FÜR DEN GEBRAUCH IM LABORATORIUM UND FÜR DAS SELBSTSTUDIUM. Von N. MENSCHUTKIN, Professor an der Universität zu St. Petersburg. DEUTSCHE AUSGABE UNTER MITWIRKUNG DES VERFASSERS, Uebersetzt von Dr. O. BACH; Zweite verbesserte Auflage. Leipzig: Verlag von Quandt und Händel, 1886. London: H. Grevel, 33, King Street, Covent Garden.

This excellent work, to which no higher commendation can be given than to state that Bunsen recommends and uses it in his laboratory in Heidelberg, has reached its second edition. The volume is of 8vo size, is bound in the usual paper cover, and contains a Preface, a Table of Contents, 459 pages of subject-matter, and an Alphabetical Index. The general scheme of the work may be gathered from the following excerpt from the "Inhaltsübersicht":—Einleitung: 1. Theil, Die Metalle. 2. Theil, Metalloide. 3. Theil, Beispiele zur qualitativen Analyse. 4. Theil, Beispiele zur quantitativen Gewichtsanalyse. 5. Theil, Beispiele zur quantitativen Maassanalyse. 6. Theil, Analyse der organischen Verbindungen.

OILS AND VARNISHES. Edited by JAMES CAMERON, F.I.C., Analyst in the Laboratory, Somerset House. London: J. and A. Churchill, 11, New Burlington Street.

OCTAVO volume, bound in cloth. One of Churchill's series of Technological Hand-books. It contains, besides Table of Contents and Alphabetical Index, 356 pages of subject-matter, 14 wood-cuts, and a useful Appendix containing various tables of value. The Chapters bear the following signatures:—I. Chemistry of Oils, Glycerine, Organic Acids, etc. II. Animal Oils. III. Vegetable Oils—Fixed. IV. Vegetable Oils—Volatile or Essential. V. Empyreumatic, Medicated, Mixed, and Perfumery Oils. VI. Waxes. VII. Mineral Oils. VIII. Purification, Bleaching, and Refining of Oils. IX. Testing of Oils—(i.) Purity; (ii.) Lubricating Qualities; (iii.) Illuminating Efficiency, etc. X. Resins and Varnishes. XI. Testing Resins.

Monthly Patent List.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

5483 W. H. W. Wilkinson, London. Improved apparatus for vapourising chemical agents and directing the vapour on to surfaces or into cavities. April 20

- 5515 A. Waldbaur, London. Improvements in centrifugal machines. April 21
 5535 W. Firmin, London. Improvements in or relating to syphons. April 21
 5539 Nestor Frere, London. Improvements in the construction of centrifugal pumps and fans for blast and exhaust purposes. April 22
 5631 J. W. Holland, London. Improvements in machinery or apparatus for producing pressure or a varied degree of vacuum. Complete specification. April 21
 5618 T. Matthews, Manchester. Improvements in apparatus for refrigerating or producing and utilising cold. April 21
 5609 C. W. Rabitz, London. Improvements in filtering apparatus. April 24
 5655 F. H. Moldenhauer, London. Improvements in feeding boilers with a combination of water and air. Complete specification. April 27
 5734 J. R. Alsing, London. An improved triturating mill. Complete specification. April 27
 5854 J. Roberts, Oldham. A non-conductor of heat styled non-conducting composition applicable to steam boilers, etc.; can be applied dry in blocks or segments. April 30
 5897 L. W. Leeds, London. Improvements in and connected with boilers heated by gas. April 30
 6022 G. E. Dow, London. Certain improvements in air or gas compressors. Complete specification. May 1
 6065 A. R. Gray, Edinburgh. An improved apparatus for the washing of ores and other minerals. Complete specification. May 1
 6112 G. F. Redfern, London—Communicated by P. Lauth, France. An improved apparatus for drying or desiccating germinating barley and other pulverulent matters. May 5
 6213 E. Edwards, London—Communicated by A. Huguet, France. Improvements in pressing machinery for separating liquid from solid or semi-solid substances. May 7
 6282 F. N. Mackay, Liverpool. Improvements in apparatus for effecting the absorption of gases by liquids. May 10
 6310 C. C. Gilman, London. Improvement in means for filtering. Complete specification. May 11
 6195 J. G. Lorrain, London. Improvements connected with the deposition of finely-divided solid matter floating or suspended in air or gases. May 11
 6499 F. Freeman, London. Improvements in apparatus for automatically delivering liquids or solids. May 11
 6302 A. M. Clark, London—Communicated by M. M. Bair, France. Improvements in the construction of furnaces, muffles, and other heating apparatus. May 11
 6303 A. M. Clark—Communicated by M. M. Bair. An improvement in the construction of furnaces and other heating apparatus. May 11
 6510 H. G. Worsam and H. Hunt, London. Improved means for preventing the deposit of solid matter on the circulating tubes of apparatus for heating and cooling water and other liquids; also applicable to the water-tubes of steam boilers. May 11
 6628 H. E. Newton, London—Communicated by A. L. G. Dehne, Germany. Improvements in filter-presses for use under high pressures. May 17
 6673 E. Fales, London. Improvements in smoke-consuming furnaces. Complete specification. May 18
 6723 J. T. Stammers, London. Improvements in apparatus for disintegrating or pulverising and sifting charcoal or other substances. May 19
 6750 A. B. Cunningham, London. Improvements in gas furnaces. May 19
 6813 J. G. Lorrain, London. Improvements in filtration. May 20

COMPLETE SPECIFICATIONS ACCEPTED.*

1885.

- 7126 J. G. Lorrain. Improvements in chemical precipitation, and in the separation of matter mechanically suspended in liquids. April 23
 7958 W. H. Hartland. Improved means for filtering and purifying water. April 27
 8162 W. Hucks. Separation or filtration of solid and liquid matter. May 21
 8199 W. Allen. Acid taps and valves and seats for chemical works. April 30
 9234 M. Coulson. Apparatus for heating, purifying, and softening water for boilers. May 4
 12513 P. Parker. Improvements in construction of water filters. April 30
 11535 R. Dick and R. Kennedy. Mercurial vacuum pumps. May 4

1886.

- 2258 O. W. Bennett. Carburetting apparatus. April 23
 3412 G. H. Moore. Methods and apparatus for refining fluids. May 11
 3857 J. R. Alsing. Improved mode of triturating, and apparatus for such purpose. May 7
 3964 G. F. Redfern—C. A. Johansson. Improved centrifugal separating machine. May 11
 4012 O. Klauhnig. Apparatus for evaporating and drying solutions, etc. April 30

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Specifications thus advertised are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

- 4159 J. R. Alsing. Improved triturating cylinder. May 7
 4656 J. S. Sawrey. Improvements in filters. May 7
 5340 J. R. Alsing. Construction of triturating cylinders. May 18

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

- 5163 H. S. Forbes, London. Improvements in producing and utilising hydrocarbon gas. April 20
 5522 T. F. V. C. Otto and C. Otto & Co., London. Improvements in coke ovens. April 21
 5597 J. J. R. Humes, London. Improved means for preventing "back ignition" in hydrocarbon engines. April 22
 5715 J. Lyle, Glasgow. Improvements connected with the burning of oils or other hydrocarbon fluids for the production of heat. April 27
 5727 T. Nicholson, Abergyle. Improvements in the methods and appliances for obtaining and cleansing gas from coal. April 27
 5801 E. Phillips, London. Improvement in petroleum oils. April 28
 5836 J. Holden, London. Improvements in the application of liquid fuel to the furnaces of locomotive engines; also applicable to the furnaces of portable and other engines. April 29
 5915 W. S. Sutherland, Liverpool. Improvements in gas-making apparatus for producing heating and illuminating gas. May 1
 6059 J. Holden, London. Improvements in the use of liquid fuel as auxiliary to ordinary solid fuel in the fire boxes of locomotives or boilers of similar type. May 4
 6253 P. M. Justice, London—Communicated by La Société de Produits Réfractaires de St. Ghislain, Belgium. Improvements in and connected with furnaces for the manufacture of illuminating and heating gas. May 8
 6347 O. Imray, London—Communicated by J. B. Archer, United States. Apparatus for conversion into gas, and combustion of liquid hydrocarbons. Complete specification. May 11
 6348 O. Imray—J. B. Archer. Boiler furnaces for combustion of gaseous fuel. Complete specification. May 11
 6349 O. Imray—J. B. Archer. A process and apparatus for manufacturing water-oil gas. Complete specification. May 11
 6362 H. J. Haddan, London—Communicated by H. Welsh, United States. Improvements in apparatus for promoting the combustion of fuel. Complete specification. May 11
 6511 F. W. Clark, London. Improvements in machinery or apparatus for the manufacture of gas for illuminating and heating purposes. May 11
 6531 W. Foulis, Glasgow. An improved apparatus for heating by gas. May 15
 6551 J. Wright, T. Charlton, and T. S. Wright, London. Improved methods for combining atmospheric air with petroleum or other liquid or gaseous hydrocarbons; and also improved appliances for using the said combinations for the production of motive power, being, more briefly, improvements in petroleum and such-like engines. Complete specification. May 15
 6620 H. J. Haddan, London—Communicated by L. von Wohlfahrt, S. Heumann, and E. Heumann, Austria. Improvements in candles. May 17
 6647 E. Mansfield, Manchester. Improvements in apparatus for manufacturing gas from oil. May 18
 6811 J. Mactear, Glasgow. Improvements in the combustion of gas for illuminating purposes. Complete specification. May 20

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 7157 C. J. C. Bailey and S. C. Dean. Making and utilising water- and oil-gas. May 11
 7643 L. A. Groth (F. Garavagnoe & Co.). A new or improved gas carburetting apparatus. May 11
 7815 H. Dempster, jun. Construction of stand-pipes for gas retorts. May 7
 12686 S. F. Smith. Apparatus for carrying off the products of combustion of gas or other lights. April 30
 13014 N. H. Henderson. Apparatus for distilling shale or other mineral oil or petroleum. April 30

1886.

- 4016 W. P. Thompson—A. I. Ambler. Apparatus for the production and utilisation of vapour fuel. April 23
 4091 W. M. Fraser. Apparatus and arrangements for distilling mineral oils. April 27
 4099 A. Dempster. Apparatus for purifying and enriching coal-gas. May 7
 4169 B. Loomis. Processes and apparatus for manufacturing gas. May 18
 5024 H. H. Lake—L. Cline. Improved artificial fuel. May 14

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

APPLICATIONS.

5944 J. Yates, London. Improvements in apparatus for the distillation of tar, and for heating other heavy or semi-fluid matters. May 1

COMPLETE SPECIFICATION ACCEPTED.

1885.

7079 J. Hardman. Improvements in, and apparatus for, obtaining carboic acid and other tar acids from tar oils. May 11

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

5846 J. Y. Johnson, London—Communicated by The Farbenfabriken vormals, F. Bayer & Co., Germany. A process for producing a new sulpho-acid and obtaining azo-dyes therefrom. April 29

5938 R. Barringer, J. H. Wallis, and W. Barringer, London. Improvements in the manufacture or preparation and application of blue colouring matters for laundry purposes. May 1

6000 H. Baum, London. A process for the production of para-resanilin and its homologues, as well as monoditrialkylised, phenylised, or naphthylised derivatives thereof. May 3

6001 H. Baum, London. A process for the production of chloride or bromide of nitro-benzyl. May 3

6070 H. H. Lake, London—Communicated by C. N. Waite, United States. Improvements in and relating to mordants for use in dyeing or printing calico and other fabrics. Complete specification. May 1

6190 L. Landsberg, London. Processes for the preparation of *m*-methoxy-*p*-nitrobenzaldehyde for use in the manufacture of vanillin. Complete specification. May 7

6143 J. H. Johnson, London—Communicated by The Badische Anilin and Soda Fabrik, Germany. The preparation from gallic acid of a yellow colouring matter suitable for dyeing and printing. May 12

6124 L. J. B. A. J. Bouillet, London. Manufacturing ultramarine-blue in blocks by special ovens for baking and colouring same, with recuperation of sulphurous vapours. May 13

6631 J. H. Johnson, London—Communicated by The Badische Anilin and Soda Fabrik, Germany. Improvements in preparing printing colours and solutions of colouring matters suitable for printing and fixing aniline colours upon cotton or similar vegetable fibre. May 17

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

8211 T. Frusher. Manufacture of ink from waste dye liquors. May 21

9510 H. J. Haddan—Farbenfabriken vormals, Bayer & Co. Manufacture of violet and blue azo-dyes. May 21

11424 J. Y. Johnson—Farbenfabriken vormals, Bayer & Co. Manufacture of azo-dyes. May 7

V.—TEXTILES: COTTON, WOOL, SILK, ETC.

APPLICATIONS.

5550 J. H. Charnley, Horsforth. An improvement in the manufacture of spun silk yarns. April 22

5911 W. Saunders, London—Communicated by R. H. Collyer, United States. Improvements in machinery for the preparation of fibrous vegetable substances for textile purposes. May 1

5987 E. Edwards, London—Communicated by C. Welté, France. An improved composition for dressing cotton, wool, linen, hemp, or other fabrics. May 3

6205 L. Turner and A. Turner, London. An improved manufacture of elastic fabrics. May 7

6638 A. Dronsfield, Manchester. An improvement in or applicable to machinery used in the preparation of textile materials. May 18

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

8402 J. F. Giraud. A new or improved size for sizing raw silk. May 11

8792 W. Mather. Apparatus for treating textile materials with liquids, gases, or vapours. May 21

1886.

4323 B. Fiegel. Removing gummy, resinous, and oily matters from fibrous spun or woven materials. May 21

4471 H. H. Lake—T. J. Waring. Preparation of animal fibres for felting. April 30

4780 E. Tweedy, H. L. Brevoort, and I. L. Roberts. Preparing fur for felting. May 7

4781 Tweedy, Brevoort and Roberts. Preparing fur for felting. May 7

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

6116 A. M. Clark, London—Communicated by J. Hanson, United States. Improvements in machinery for dyeing yarns. Complete specification. May 5

6435 H. Broadbent and A. E. Hawley, Halifax. Improved machinery for dyeing or otherwise treating hosiery and other like goods or fabrics. May 13

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

8794 W. Mather. A process for bleaching vegetable textile fabrics. May 18

9690 T. Salt and W. Stead—F. Pasquay. Apparatus for washing, scouring, bleaching, dyeing, etc., fibrous material in the form of slivers, slubbings, rovings, yarns, or fabrics. May 21

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

5156 T. T. Mathieson and J. Hawliczek, Liverpool. A method for purifying crude carbonate of soda, termed "black ash," and the recovery of ammonia therefrom. April 20

5542 D. G. Fitzgerald, London. The regeneration or production of chromic acid from exhausted battery and other solutions. April 21

5673 J. Hargreaves, T. Robinson and J. Hargreaves, Liverpool. Improvements in treating hydrochloric acid to obtain chlorine, using the said chlorine in the manufacture of bleaching powder, and in apparatus employed. April 27

5681 J. Hargreaves, T. Robinson, and J. Hargreaves, Liverpool. Improvements in treating pyrites, and in apparatus employed therein. April 27

5682 J. Hargreaves, T. Robinson, and J. Hargreaves, Liverpool. Improvements in the manufacture of sulphates of soda and potassa, and in apparatus therefor. April 27

5683 J. Hargreaves, T. Robinson, and J. Robinson, Liverpool. Improvements in obtaining carbonate of soda and sulphur from sulphate of soda, and in apparatus employed therein. April 27

5838 J. Hepworth and E. Marriott, Manchester. Improvements in the removal of ammonia from coal gas, and in the manufacture of ammoniacal salts therefrom, and in apparatus employed in such process. April 30

6386 G. Chapman, Glasgow. Improvements in the method of manufacturing soda by what is called the ammonia soda process. May 12

6468 W. Simon, London. Improvements in the manufacture of bicarbonate of potash. May 13

6492 W. H. Munns, London—Communicated by P. Farinaux, France. Apparatus for producing carbonic acid under constant pressure. May 14

6573 R. Weiss, London. Process for the production of alumina compounds applicable for bleaching. May 15

6734 R. H. Wilson, Durham. Improvements in the manufacture of anhydrous sulphuric acid, and in apparatus therefor. May 20

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

5544 B. H. Thwaite and J. Pedder. The utilisation and method of using liquid hydrocarbons as carbonising and neutralising agents in the alkali processes and for reducing pyrites. April 27

7285 R. Oxland and C. Oxland. Apparatus for burning or calcining ores and minerals containing sulphur or arsenic, for the manufacture of sulphuric acid or arsenious acid, or white arsenic. May 4

7831 T. Copper—Dr. S. Pick. Apparatus for making bicarbonate of sodium. May 4

8282 H. Richardson. Manufacture of hydrate, sulphate, and other salts of alumina. May 4

8502 N. Glendinning. Treatment of copper liquors. May 21

8723 W. P. Thompson—Solvay & Co. Filters applicable for caustic soda solution. May 7

8933 F. Brunjes. Production of carbonate of potassium from chloride of potassium or sulphate of potassium. May 21

1886.

1915 J. Maetear—J. Kolb. Obtaining chlorides of barium and strontium. May 4

3220 A. Dempster. Apparatus for distilling ammoniacal liquor for producing sulphate of ammonia. April 23
 3222 B. J. B. Mills—Verein für Chemische Industrie. Producing chlorine, and chlorine and ammonia. April 30

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

5698 H. Forrester, Stoke-on-Trent. Marbling earthenware and china in enamels by means of oiling and dusting. April 27
 5748 W. W. Pilkington, Liverpool. Improvements in apparatus for use in casting plate glass. April 28
 5978 F. Winterhoff, Hammersmith. A new or improved process for producing ornaments, lettering, etc., on glass or other round or flat substances, for decorating and advertising purposes. May 3
 6114 R. Young and R. Jex-Long, Glasgow. Improvements connected with the manufacture of fireclay tuyères, and in the machinery or apparatus employed therefor. May 6
 6681 J. French and J. Craig, London. Improvements in the process of manufacturing rolled plate glass, and in the machinery employed therefor. Complete specification. May 18

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

4060 F. G. Johnson and A. Johnson. A "link press" for making earthenware, etc. April 30
 7341 E. S. Tucker and D. F. Tucker. Manufacture of various articles from spar, refuse marble, glass, and the like. May 11
 11351 J. Slater. Ornamenting glass, china, or other vitreous surfaces. May 1
 12762 J. C. Belfield. Furnace for burning dross or slack in the firing of all kinds of earthenware. May 11

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

5843 C. J. Howe, London. Improvements in the manufacture of cement or plaster. April 29
 5844 C. J. Howe, London. Improvements in the manufacture of cement or plaster. April 29
 5975 A. J. Boulton, London—Communicated by A. Grasset and A. C. Mallat. Improvements in the manufacturing of cement. May 3
 5991 J. H. Edge and J. Edge, London. Improvements in dies for the manufacture of roofing, flooring, and other tiles, bricks, and other like articles made of clay. May 3
 5991 G. Mancion, London. An improved process for preserving timber. Complete specification. May 3
 6061 L. A. Groth, London—Communicated by F. L. Perrière, France. Improvements in roofing tiles. Complete specification. May 4
 6212 E. Edwards, London—Communicated by C. Hubert and H. Gennari, France. Improvements in apparatus for forming compressed blocks for building and other purposes. May 7
 6221 C. S. Williams, London. Improvements in the construction of fire-proof floors. May 7
 6520 G. R. Redgrave, London. Improvements in the treatment of sewage-water by the lime process for the production of cement. Complete specification. May 15
 6533 T. Smith, London. An improved method of utilising metallic and other cements, plaster-of-Paris, and such like substances. May 15
 6698 L. White, London. Improvements in the manufacture of cements and plasters. May 18

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

6813 C. Kingsford. Drying and evaporating apparatus for use in the manufacture and treatment of cement, etc. May 18
 8139 G. F. Redfern—R. Tanczos. Process for rendering wood incombustible. May 11
 8361 J. Matthew. Treatment of stone to produce a glazed surface thereto. April 23
 8508 R. Stanley. Machinery for pressing and moulding bricks, tiles, etc. May 4

X.—METALLURGY, MINING, ETC.

APPLICATIONS.

5527 A. de Laude Long and R. Howson, London. A new manufacture of fibrous iron. April 21
 5560 F. Burklam, Wellingborough. The substitution of sheet steel as a material for the making of pig (and other) patterns, instead of wood or other material now in use. April 22

5762 H. B. Fulton, Kirkintilloch. Treatment of copper precipitate, regulus or ore, for the purification thereof. April 23

5832 J. Y. Johnson, London—Communicated by La Société Anonyme Le Ferro-Nickel, France. An improved manufacture of alloy of nickel, copper, and aluminium. April 29
 5921 F. J. R. Canilla, London. Improvements in the manufacture of steel and ingot iron. May 1

6002 W. Perrott, London. Lining steel converters or open hearth furnaces, also forming blowing plugs with a new material locally called "curlstone," which material is distinct in its features from any previous material used for such purpose. May 3

6066 J. H. Johnson, London—Communicated by A. de Meritens, France. A process for preserving iron and steel. May 4

6128 G. Craig, Glasgow. A new or improved treatment of blast furnace or other slags for subsequently obtaining useful products therefrom. Complete specification. May 6

6145 A. C. Henderson, London—Communicated by L. T. Heroult, France. An improved process for the preparation of aluminium by electrolysis. May 6

6217 H. Johnson, London. Improvements in blasting and getting coal and other materials, and in tunnelling, and in apparatus employed for those purposes. May 7

6251 W. D. Allen, London. Improvements in casting iron and steel ingots. May 8

6281 T. Doughty and A. Doughty, Glasgow. Soaking mould for steel ingots. May 10

6300 J. M. Bennett, Glasgow. Improvements in smelting and refining of gold, silver, copper, zinc, lead and tin ores, and in furnaces therefor. May 10

6367 P. A. Newton, London—Communicated by C. A. Pailard, Switzerland. Improvements in metallic alloys. Complete specification. May 11

6372 H. H. Lake, London—Communicated by E. E. Wood, United States. Improvements relating to the rolling and welding of iron and steel, and to fluxes therefor. Complete specification. May 11

6401 A. Gutensohn, London. Improvements in the process for coating the surface of iron or other metals with tin, lead, or terno. Complete specification. May 12

6405 A. Gutensohn and A. Cox, London. An improved flux to be used in the process of coating iron or steel with lead. May 12

6545 J. H. Goodwin and F. James, Sheffield. Improvements in the manufacture of compound ingots and in apparatus used therein. May 15

6550 T. Slater, London. Improvements in the manufacture or production of metallic alloys. May 15

6571 W. D. Houghton and A. M. Walker, London. Improvements in the manufacture of steel in Bessemer converters and open hearth furnaces. May 15

6572 W. D. Houghton and A. M. Walker, London. Improvements in the manufacture of steel in Bessemer converters and open hearth furnaces. May 15

6609 E. Fox and L. Regnier, London. Improvements in furnaces for use in heating or melting metals. May 17

6717 A. M. Clark, London—Communicated by La Société Anonyme de Produits Chimiques de St. Denis, France. Process and apparatus for the treatment of iron ores for the manufacture of steel. May 19

6786 J. Thomas, H. Lewis, E. W. Lewis, and T. L. Thomas, London. Improvements in the method of and apparatus employed in galvanising (coating with spelter) sheet metal. May 20

6803 E. Edwards, London—Communicated by M. Ramos-Garcia, France. An improved process for the separation of metallic tin from tinned plates, or from alloys or salts of tin. May 20

6810 J. Noad, London. Improvements relating to the extraction or separation of gold, silver, and platinum from ores and other substances or products containing such metals. Complete specification. May 20

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

5110 J. Gilligan. Manufacture of puddled iron and steel. April 23

5669 T. Timothy. Improvements in annealing pots. May 4
 5702 D. Edwards, R. Lewis, and P. Jones. Coating metal plates with tin or other metal. May 7

6018 H. Aitken. Treatment of carbonaceous, bituminous, calcareous and other substances, such as ores, to obtain products therefrom. May 4

6674 A. E. Scott. Process and apparatus for separating metals from their ores. May 21

6711 W. R. Lake—B. Atha. Manufacture of metal ingots, and apparatus therefor. April 23

6718 B. D. Healey and B. H. Thwaite. Application of gaseous fuel for smelting ores, and furnace crucible and other plant therefor. May 7

7012 H. H. Lake—H. E. Cahen. Manufacture of steel. May 21

7538 D. Hickie. A "miner's knife," with appliances combined for preparing charges of explosives for mining and blasting operations, and for lessening risks in the manipulation of such charges. May 11

8677 J. Riley. Manufacture of steel in regenerative open-hearth furnaces. May 21

8756 H. White. Manufacture of steel and iron, and converters to be used in such manufacture. May 11

8981 T. Hampton and J. Facer. Improvements in method of casting steel ingots. May 11
11311 J. Robb. Methods and composition for case-hardening metals. May 11

1886.

3389 J. E. Craig. Manufacture of polished sheet iron. April 23
3985 C. E. Steinweg. Plating metals and alloys. April 23
4034 C. L. Hartsfeld. Portable blast furnace plant. May 11
4402 B. Ford and J. Moncur. Regenerative hot-blast stoves. May 7
4750 J. W. Hall—G. T. Lewis. Process for treating lead and other ore for obtaining the metal therefrom, and for the manufacture of white pigment. May 7
4956 H. Kesterton. Manufacture of metallic alloys. May 11
5222 J. Heath and W. Frost. Blasting and shot firing in mines, and appliances relating thereto. May 18.

XI.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

5769 T. Rockliffe and G. J. Bowes, London. Improvements in soap making machinery, partly applicable for use in moulding other plastic materials. April 28
5792 A. J. Boulton, London—Communicated by E. Oppelt, Spain. Improvements in apparatus for the extraction of oils or other vegetable juice. April 28
6170 W. Green, London. Improvements in the manufacture and treatment of soap. May 6
6172 F. P. Warren, Cosham. Improvements in lubricants. May 7
6210 H. W. Langbeek and R. E. Mitsert, London. Method for the separation of cholesterol fats from commercial wool fats, and from the leys of wool-washing works. May 7
6465 E. P. Chauvet and E. A. Delrieu, London. An improved receptacle or device chiefly designed for containing oleaginous seeds during the expression of oil therefrom. May 13
6736 J. S. Edwards, London. Improvements in the treatment of fish and other matters to extract oil therefrom, and in apparatus to be employed therein. May 19

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

8230 F. Walton. Manufacture of oxidised or solidified oil and in the application of the same to wires and strands. April 23
8403 A. Michel. Apparatus for treating fatty matters, in order to obtain fatty acids and glycerine therefrom. April 23

1886.

3987 J. Townsend. Improvements in making soaps. April 23
4936 T. E. Gardner. Improvements in marking soap. May 11
4994 J. Higson. Manufacture of soap for the removal of warts. May 14

XII.—PAINTS, VARNISHES, AND RESINS.

APPLICATIONS.

5820 J. Warwick, Newcastle-on-Tyne. Improvements in the manufacture of white lead. April 29
6370 R. Lavender, London. Improvements in the manufacture of oxide of iron pigment colour. May 11

XIII.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

5476 P. Haddan, London—Communicated by The Dobson Patent Tanning Process Co., United States. Improvement in tanning hides. Complete specification. April 20
5491 N. A. Alexanderson and L. Hvass, Stockholm. A mode of tanning hides and skins. Complete specification. April 20
5619 J. Hall and A. Hall, Leeds. Improvements in machinery employed in the manufacture of leather for setting, scouring, striking or pinning, printing, rolling, slicking, fleshing, un-hairing, whitening, shaying, and brushing. April 24
6011 F. R. Maggs, Yeovil. The preparation of leather and skins by a substitute for "urine" or "sig" in the process of brushing leather and skins preparatory to dyeing. Complete specification. May 4
6438 R. Baker and W. Baker, London. Improvements in the manufacture of seal splits or fleshings. May 13

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

10147 J. C. Mewburn—J. Marchal and L. Bories. Process of treating tannic extracts or juices. April 27

1886.

5049 H. S. Barrow. Machines for grounding and softening skins or leathers. May 14
5476 P. Haddan—The Dobson Patent Tanning Process Co. Improvements in tanning hides. May 21

XIV.—AGRICULTURE, MANURES, ETC.

APPLICATIONS.

5686 H. J. Allison, London—Communicated by W. S. Pierce, United States. Improvements in fertilising compounds, and in the process of manufacturing the same. Complete specification. April 27
5864 W. H. Keys, West Bromwich. "Cresylline"—destroying wire-worms and other insects in gardens and land. April 30
5732 T. H. Cobley, London. Improvements in the treatment of sewage sludge, and the preparation of a fecal guano therefrom. May 19

XV.—SUGAR, GUMS, STARCHES, ETC.

APPLICATION.

5735 J. Guardiola, London. An improved evaporating apparatus for saccharine and other juices. April 27

COMPLETE SPECIFICATION ACCEPTED.

1885.

4516 P. Jensen—M. C. P. Barbe. Apparatus for the manufacture of refined sugar. May 4

XVI.—BREWING, WINES, SPIRITS, ETC.

APPLICATIONS.

5457 W. S. Squire, London. Improvements in the manufacture of yeast. April 20
5511 W. S. Squire, London. Obtaining useful products from distillers' spent wash. April 21
5772 F. Faulkner and W. Adlam, London. Improvements in treating brewers' wort. April 28
5796 J. Painter, Malmesbury. The manufacture of a new article entitled "Maltina," aerated or non-aerated. April 28
6069 S. A. W. Howmann, London. Improvements in manufacturing compressed yeast. May 4
6401 H. Schaarwachter, Barmen. An apparatus for Pasteurising (d'asteriser) beer, wine, and other suitable fluids. May 12
6658 J. Luth, Glasgow. Improvements in apparatus for cooling beer and other liquids or fluids. May 18
6686 R. Jones, London. Improvements in the treatment of alcohol and other fermented or fermentable liquids. May 18

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

7736 T. J. Canty. Self-acting apparatus for heating and circulating worts in brewers' mash tins. April 23
8908 G. J. W. Peters. Improved process of purifying yeast. May 11
8925 A. Ralu, jun., J. Grathwohl, and H. A. Browne. Preparation and treatment of sweet potatoes, yams, and arums, and manufacture of spirit therefrom. May 14
9068 R. C. Sinclair and J. Hodson. Apparatus for effecting the turning of malt, etc., on the drying floors of kilns. May 11
11125 J. Hodson. Improvements in and apparatus for tuning or cleansing beer. May 11

1886.

1461 F. Faulkner and G. R. Wilson. Method and apparatus for treatment of beer returns and other like alcoholic liquids. May 18
5152 N. Pigeon and W. L. Flanagan. Manufacture of ale, beer, and porter. May 11

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, ETC.

APPLICATIONS.

A.—CHEMISTRY OF FOODS.

5484 R. T. Strangman, London. Improvements in apparatus for the reception, preservation, and conveyance of food, liquids, and perishable articles generally. April 20
5658 H. W. Hart, London. Treating chocolate to render it digestible. April 21

5833 J. C. Benit, Peckham. The preservation of milk or cream without the addition of any ingredient. April 29
 5916 S. Preston, London. Improvements in the manufacture of bread. May 1
 6332 E. J. T. Digby, London. The preparation of a nutritious and hygienic biscuit for horses and other animals. May 11

B.—SANITARY CHEMISTRY.

6067 G. D. Robertson, London—Communicated by R. James, United States. Improvements in filtering sewage. May 1
 6283 F. Kingdon and G. Wilde, Bradford. Improvements in destructors or furnaces for destroying refuse. May 10
 6306 J. S. Edwards and J. Edwards, London. Apparatus for drying waste animal matter, and for like uses. May 10

C.—DISINFECTANTS.

5930 T. Terrell, London. A chemical compound for destroying insects. May 1
 6120 W. G. Little, Rotherham. Improvements in insecticides. May 6
 6191 W. D. Borland, London. The manufacture of bromine preparations for sanitary and other purposes. May 7

COMPLETE SPECIFICATIONS ACCEPTED.

A.—CHEMISTRY OF FOODS.

1886.

1989 F. W. Wendenbury. Manufacturing food for cattle, etc., from wood, meal, or powder. May 11

B.—SANITARY CHEMISTRY.

1885.

8690 C. Jones. Furnaces for treating town refuse. May 21
 10137 W. Spence—Communicated by F. Sanders. Apparatus for removing sewage or other impurities from cesspools, sinks, etc. May 1

C.—DISINFECTANTS.

1885.

12238 A. Boake and F. G. A. Roberts. Improvements in disinfectants. May 21

1886.

4117 A. L. Dussek. Improvements in antiseptics and disinfectants, and in the manufacture thereof. April 30
 5151 H. H. Lake—Communicated by F. L. Sarmiento, W. G. Grini and others. Improvements in disinfecting compounds. May 11

XVIII.—ELECTRO-CHEMISTRY.

APPLICATIONS.

5179 S. C. C. Currie, London. A method of gauging electric currents, and apparatus for that purpose. April 20
 5531 W. T. Goolden, A. P. Trotter, and H. W. Ravenshaw, Westminster. Improvements in pole pieces of dynamo-electric machines and motors. April 21
 5532 W. P. Thompson, Liverpool—Partly communicated by The Cowles Electric Smelting and Aluminium Co., United States. Improvements in or relating to electric furnaces on the Cowles principle, to the manufacture of chemicals by means of such furnaces, and to the utilisation of substances obtainable thereby. April 21
 5588 W. M. Mordey, London. Improvements in dynamo-electric machines. April 22
 5611 H. H. Lake, London—Communicated by The Helios Electric Light and Telegraph Construction Co., Germany. Improvements in machinery or apparatus for the generation of electric currents. Complete specification. April 22
 5731 A. Dunn and F. Hasslacher, London. Improvements in galvanic batteries. April 27
 5817 S. F. Walker, Cardiff. Improvements in galvanic batteries. April 29
 5839 E. Conry, Hammersmith. Transforming or converting electrical energy, and apparatus therefor. April 29
 5855 F. W. Braoson, Leeds. An improved galvanic battery. April 30
 5971 A. W. Armstrong, Lewisham. Improvements in or connected with electrical batteries and appliances. May 3
 6075 A. Hégulus, Moreux, France. Improvements in galvanic batteries. May 1
 6114 D. G. Fitzgerald, London. Improvements in chronic acid batteries. May 5
 6203 H. J. Haddan, London—Communicated by C. Steel, Germany. Improvements in the preparation of carbon filaments for electric lamps. May 7
 6235 J. Enright, London. A reversible electric machine. May 8
 6245 C. Wells, London. Improvements in electric machines. May 8
 6287 W. Taylor, London. Improvements in electric secondary or storage batteries. May 10
 6422 J. G. Statter and S. L. Brunton, London. Improvements in armatures for magneto or dynamo-electric generators or motors. May 12

6508 R. P. Sellon, London. Improvements in electric meters. May 11
 6669 W. S. Johnson, London. Improvements in electric valves. Complete specification. May 18
 6697 N. Glouchoff, London. Improvements in dynamo-electric machines. May 18
 6806 T. Mace, London—Communicated by The Vitrite and Luminoid Co., United States. Improvements in the preparation or manufacture of materials suitable for use as the incandescing medium of electric lamps, and for other purposes where a refractory and electro conductive material is required. May 20

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

7222 J. Y. Johnson—La Société A. Chertemps & Cie. Manufacture of carbon for electric lamps and other electrical apparatus. May 1
 7700 C. D. Abel—M. Lahaussais. Electro magnets and induction coils. May 4
 8510 F. H. W. Higgins. Improvements in voltaic batteries. April 27
 8733 W. H. Quartermao. Improvements in galvanic batteries. May 11
 8808 W. B. Nation. Application of electricity to the treatment of vegetable fibre for the production of half stuff. May 21
 8881 W. P. Thompson—E. Julien. Improvements in secondary batteries, partly applicable to primary batteries. May 11
 9145 J. H. Johnson—L. A. W. Desruelles. Electric batteries. May 21

1886.

723 R. Kennedy. Electro field magnets for dynamo-electric machines and electro motors, etc. May 18
 4523 H. Muller. Improvement in induction apparatus or secondary generators. May 7
 5273 H. P. Holt. Arrangement for mounting and driving dynamo-electric machines. May 21

XIX.—PAPER, PASTEBOARD, ETC.

APPLICATIONS.

5563 W. E. Heys, Manchester—Communicated by E. G. H. Ladewig, Prussia. Improvements in the manufacture of water and fireproof paper, millboard, and similar materials. April 22
 5929 J. Collins, London. Improvements in the manufacture of diaphanous and air-tight paper. May 1
 6385 J. G. Dunbar and A. McKenzie, Glasgow. Improvements in apparatus for regulating the supply of pulp or stuff to paper-making machines. May 17
 6654 W. Tijen, London. Improvements in steam jacketted boilers for converting wood and other fibre into pulp suitable for manufacture into paper or other articles prepared from pulped fibre. May 18

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

7158 H. H. Lake—A. D. Beaunier. Manufacture of cardboard or pasteboard, and apparatus therefor. April 30

1886.

3111 H. Watson. Strainer plates used in the manufacture of paper. April 23
 3172 J. D. Tompkins. Process for making paper stock or pulp. May 21

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

APPLICATIONS.

5936 E. Edwards, London—Communicated by E. A. Viteau, France. An improved process for the complete purification or perfumes in the manufacture of which sulphuret of carbon has been used. May 1
 6250 C. D. Abel, London—Communicated by La Société Anonyme des Parfums Naturels de Cannes, France. Improvements in the extraction of perfume essences. May 8
 6588 C. E. Landon and J. Wilson, Birmingham. An improved method of mixing chloroform with water. May 17
 6696 P. Joske, London. The preparation of medicinal extracts from the Kava or Yagona plant, scientifically known as the "Piper methisticum," and the preparation of beverages from, and the treatment of spirit with such extract. May 18

COMPLETE SPECIFICATION ACCEPTED.

1885.

8810 G. Brownen. The preparation of extracts and beverages from the leaves of the coca plant. April 23

XXI.—EXPLOSIVES, MATCHES, ETC.

APPLICATIONS.

5491 B. von Schenk, London. Improvements in the manufacture of substances for igniting matches, and in articles made of such substances. April 20

5788 H. E. Newton, London—Communicated by A. Nobel, France. Improvements in the manufacture and use of explosive compounds. April 28

6015 W. Brampton, Birmingham. An improved method of igniting matches, applicable to match boxes. May 4

6222 J. Macnab, London. Improvements in and connected with explosive cartridges for blasting purposes. May 7

6258 C. D. Abel, London—Communicated by F. Gaens, Germany. An improved explosive compound for blasting purposes. May 8

6340 E. L. Zalinski, London. Improvements in fuses for explosive shells and torpedoes. Complete specification. May 11

6632 T. Boek, London—Communicated by C. Libbrecht, Belgium. Improvement in gunpowder. May 18

6664 H. Schöneweg, London. Improvements in explosive compounds. Complete specification. May 18

COMPLETE SPECIFICATION ACCEPTED.

1885.

8951 D. Johnson. Manufacture of explosives. May 18

THE JOURNAL OF THE Society of Chemical Industry:

A MONTHLY RECORD

FOR ALL INTERESTED IN CHEMICAL MANUFACTURES.

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NOTICES.

ANNUAL GENERAL MEETING.

The next annual general meeting of the members of the Society of Chemical Industry will be held in Liverpool on Wednesday, Thursday, and Friday, 14th, 15th, and 16th July next.

PROGRAMME OF PROCEEDINGS.

At 11 a.m. on the morning of Wednesday, 14th July, the members will meet in the new Chemical Theatre of the University College, Brownlow Street, to transact the ordinary business of the Society, to elect office-bearers, and to hear an address by the President. By permission of the College authorities, members will have an opportunity of inspecting the new laboratories both before and after the meeting. In the afternoon alternative excursions have been arranged to the following places of interest: (a) The International Exhibition; (b) The Liverpool Gasworks; (c) Messrs. Crofield, Barrow & Co.'s Sugar Works. Particulars will be found in the Circular sent to each member with this Journal. In the evening, at 7 p.m., the Annual Dinner will take place at the Adelphi Hotel. Dinner tickets, 10s. 6d. each (exclusive of wine), may be obtained on application, accompanied by remittance, to the Honorary Secretary of the Liverpool Section, Mr. W. P. Thompson, 6, Lord Street, Liverpool. Application before July 9 is requested.

On Thursday, July 15, at 10 a.m., the members will embark at Princes' Landing Stage for a sail on the river, visiting the New North Docks, New Floating Docks, Graving Docks, Hydraulic Works, Grain Silo Warehouse and Elevator, a Transatlantic Steamer, and either the Albert Dock Warehouses or Messrs. Laird's Shipbuilding Works, as preferred by individual members. In the evening, at 8 p.m., there will be a Conversazione and Reception by the President at the Walker Art Gallery, for which each member can obtain a ticket for himself and a lady on application to Local Secretary.

On Friday, July 16, at 9 a.m., two alternative excursions start for Widnes and St. Helens, the first to visit Messrs. Gaskell, Deacon & Co.'s Alkali Works, or Messrs. Gossage & Sons' Soap Works (by ticket of admission), or the works of Messrs. The Tharsis Sulphur and Copper Co., Limited (by ticket of admission). The St. Helens excursion to visit Messrs. Bourne & Robinson's Collieries, and Messrs. Bishop & Co.'s Glass Works (by ticket of admission). A special train will take both parties on to Crewe, arriving at 12.55, and in

the afternoon the Crewe Steel and Railway Works will be visited. At 6.30 there will be an Informal Wind up Dinner in the Adelphi Hotel, Liverpool, at 3s. 6d. a-head.

Members are earnestly requested to fill in, sign, and return as early as possible to Mr. W. P. Thompson, Hon. Secretary, Liverpool Section, the Circular giving the list of works and meetings they intend to visit, as the Local Committee has undertaken to send in beforehand the names of members who will visit the various works, etc.

In accordance with the provisions of Rule 18 of the Bye-laws, notice is hereby given that those Members of Council whose names are placed in italics in the annexed list, will retire from their respective offices at the forthcoming Annual General Meeting.

PROPOSED AMENDMENT OF BYE-LAWS.

Notice is hereby given, in accordance with Rule 54, that it will be proposed to the forthcoming Annual General Meeting to further amend the Society's Bye-laws as follows:—

Bye-law 1.—That the words "and is established in accordance with the provisions of the Literary and Scientific Institutions Act, 1854," be added after the word "Industry."

Bye-law 5.—That the word "or" be inserted in the third line thereof between the words "Council" and "a professional."

Bye-law 27.—That the words "One Guinea" in the first line thereof, be replaced by the words "Twenty-five Shillings."

Bye-law 29.—That the words "is more than four months in arrear," in the second line thereof, be replaced by the words "has not been paid."

Bye-law 37.—That the word "President" in the second line thereof, be replaced by the word "Chairman."

Bye-law 42.—That the words "is in arrear with" be replaced by the words "has not paid."

Bye-law 49.—That the date "31st of December" be replaced by the date "15th of June."

Bye-law 54.—That the word "given" in the last line but one thereof, be replaced by the word "posted."

The supply of copies of the Journal for January, 1882, being now exhausted, the Secretary would be glad to receive communications from members possessing extra copies of that number, in good condition, with a view to purchase.

Should sufficient applications for complete sets be received, the number will be reprinted.

CHANGES OF ADDRESS.

J. Beveridge, 1/o Russia; 19, Rectory Road, Cardiff.
F. C. Blythe, 1/o Adswode; Newholme, Victoria Park, Manchester.

G. S. Bowler, 1/o Kensington; Crystal Palace District Gas Company, Limited, Lower Sydenham, S.E.

H. E. Bunker, 1/o South Hackney; 53, Stocks Street, Cheetnam, Manchester.

Spencer Collyns, 1/o Salford; 61, Barton Street, Moss Side, Manchester.

Wm. Donald, 1/o Salcoats; New Explosives Company, Limited, Pembrey, South Wales.

C. Hinfrey, 1/o Chester; The Villas, Parkgate, Cheshire.

A. P. Laurie, 1/o Edinburgh; 29, Artesian Road, Bayswater, W.

J. Walter Leather, 1/o Bonn; 13, Redcliffe Street, South Kensington, S.W.

J. H. Macmahon, 1/o Desoto Alkali Company; Lancashire Alkali and Sulphur Company, Widnes.

J. C. Major, 1/o Monniere Green; The Blyths, Compton, Wolverhampton.

J. A. Meynier, 1/o Rue Pare Royale; 19, Rue Baudin, Paris.

W. M. Miller, 1/o Glasgow; Tuschen den Vrienden, Demerara, West Indies.

E. Milner, 1/o Warrington; Hartford Manor, Northwich.

J. E. Riley, 1/o Hapton Chem. Co.; Arden Hall, Accrington.

E. Scott; Journals, etc., to 11, Argyle Street, Sunderland.

H. C. Shorten, 1/o Uxbridge Road; 3, Addison Road North, Kensington, W.

W. W. Staveley, 1/o West Bromwich; Baghill, Pontefract.
E. Sykes, 1/o Hill Street; 27, Nursery Street, Pendleton.

W. J. Taylor, 1/o Holborn Viaduct; c/o Prentice Bros., chemical works, Stowmarket, Suffolk.

G. I. J. Wells, 1/o Liverpool; 11 Francis Terrace, Victoria Park, London, E.

C. F. Young, 1/o Middleton; New Islington Chemical Works, Baker Street, New Islington, Manchester.

LIST OF MEMBERS ELECTED, 23rd JUNE, 1886.

J. Kinniburgh Brown, 5, Saxe Cobourg Place, Edinburgh, insurance fire superintendent.

Emmanuel Kur, 13, Bath Buildings, Huddersfield, dyer and colourist.

J. F. McFarlane, 6, Ham Frith Road, Stratford, E., chemist.

J. B. Mercer, 322, Lower Broughton Road, Manchester, manager.

G. H. Scott, Hague Bar, New Mills, near Stockport, chemical manufacturer.

Henry Sharp, Loseley Hurst, Bournemouth and Poole, firebrick manufacturer.

London Section.

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T. Hoyle.

John Spiller.

G. C. Trewby.

J. Williams.

Local Sec. and Treasurer: Thos. Tyrer.

Garden Wharf, Church Road, Battersea, S.W.

July 11, 15 and 16.—Annual Meeting at Liverpool.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held Tuesday, June 8, 1886.

MR. DAVID HOWARD IN THE CHAIR.

THE CHEMICAL TREATMENT OF SEWAGE.*

BY C. MEYMOTT THOY, M.B., M.A., F.C.S., F.I.C.

It will probably be within the knowledge of some that a few weeks back I gave an address upon Sewage at the Society of Arts. I have no intention, however, to-night, of following the same lines of thought or of treatment that I followed then. As far as I am able, I shall address myself to the special chemical aspects of the sewage question.

At the Society of Arts I ventured to give a general history of the sewage question; I do not propose to repeat that story to-night. I am compelled to admit that the subject of sewage generally is in a frightful mess. If we turn to the scientific history of the question we may find, I think, some cause for the mess. It would be very interesting to trace the subject through its many phases, but for the serious results. I have tried to follow the history, and I hope not many more of you will attempt it. Report upon report, blue book after blue book has appeared, blue book No. 2 always seeming to do its best to undo any good that might have been done by blue book No. 1, and both vieing with one another to bewilder us with facts and figures. Royal commission upon royal commission has been appointed, the members of which can scarcely have been said to have been discreetly chosen. Thus a commission was appointed to inquire into the pollution of rivers and the diseases resulting from such pollution, without any medical man having a place

* The address is from shorthand notes.

on the commission. So much for the past. Is the future brighter? Not much. The prospect looked better a few months ago, but very dark clouds have gathered lately.

Let me ask, in the first place, what is the nature of this material about which commissions have inquired and experts reported *ad nauseam*? Sewage is (in few words) the refuse of communities, their habitations, streets, and factories. That is a broad and general definition of sewage. As to its composition, it contains (1) the solid and liquid excreta of the population, (2) the washings of the streets, and (3) the fluid refuse of every branch of industry. It contains commonly a large volume of subsoil water. Sewage therefore has a complex nature. When called upon to advise upon sewage schemes, it is necessary that we should know exactly what it is with which we have to deal. So far as the excreta of the population is concerned, the question is reasonably simple. The composition of the excreta is fairly constant, as shown by the researches of many authorities, like Lawes and Way in this country, and Wolf and Lehman on the Continent. A thousand people in a mixed population contribute about 2640lb. of liquid and moist excreta per day, or 141lb. of dry deposit to the sewage; in other words, about 2½ oz. per head daily of dry matter. These results agree fairly well with the average records of a very large number of observations of different observers. Combined results are of much greater value than individual results. That, then, is the nature of the excreta. The washings of the streets is the next branch of the subject. The conditions under which observations are taken should be as nearly as possible identical, and perhaps preferably be made at the time of storm following a period of drought. On a granite road, after a heavy shower, the discharge into the gullies will contain an average of 800grs. per gallon of solid matter, of which 280grs. will be in solution, and 520grs. in suspension. I must point out that this quantity is enormously influenced by the traffic and by the character of the road. Taking an average of observations made on all sorts of roads during a heavy storm, the solid matters present were found to be 280grs. per gallon, of which 120 was in solution and 160 in suspension. The granite roads are found generally to yield the largest quantity of matter to our sewers. In the case of a wood pavement, during a heavy storm, the discharge contained a quantity of solid matter not exceeding 50grs. per gallon, of which 40 was in solution and 10 in suspension.

The excreta of the population, it will be noted, is fairly calculable, whilst it is possible to estimate the solid matter in the washings of the roads. But as to the rest of the data—they are uncertain. When you are consulted by local authorities, you will be asked to let them send you up a sample. A single sample won't tell you much. If a specimen sample is to be of any good it must be a mixture of samples taken every half-hour during the twenty-four hours. It may then probably be of some value, but even it will not go very far. There is still an important piece of information which you require. It is necessary to have the clearest information as to the place where the sample of sewage was collected, and the conditions under which it was taken. The sewage, for example, at a stagnant spot, or in a branch sewer, may be very foul, whilst the sewage ordinarily is not foul. But when all possible care has been taken in the collection of the samples, you will want to know more than any one sample of sewage can tell you. The weather has an important bearing on the quality. The first sewage after a storm usually contains an extraordinary quantity of impurity. It is important, therefore, that a second sample, taken an

hour or one hour and a-half after the storm, should be collected. It comes to this, that a sample of sewage may be submitted for your examination, which, for want of many necessary data, affords you no information upon which you can report. You cannot estimate factory refuse, except by experiment on the spot, for it varies from hour to hour. I do not intend to enter on the difficult or contentious subject of Metropolitan sewage; but, taking a large number of samples of London sewage, not collected during a storm, the quantity of solids found was on an average 94grs. per gallon, of which 56 were dissolved and 38 in suspension. At night the results gave 78grs. per gallon, 64 dissolved and 14 in suspension. The average is 90grs., 60 dissolved and 30 in suspension, and of organic matters 15grs. in suspension and 15grs. dissolved. In making an analysis of sewage, it is advisable to make an analysis of the sample (1st) as delivered, (2nd) of the liquid after the sediment has been removed, and (3rd) of the sedimentary matter. The physical qualities of sewage have a very practical bearing. The analysis will show that the clear liquid contains, besides amorphous organic matter, filaments of various fungi and the lower forms of animal life (monads, vibrios, etc.). If you expose the clear liquid to air, you then obtain the higher forms of infusoria (vorticellæ, rotifera, etc.). When the sewage decomposes and gives off sulphuretted hydrogen and marsh-gas, you will find animal life disappear, and if you dilute the sewage in this state with water and expose it to air, the bad odour goes, and the higher infusoria, the vorticellæ and the rotifera appear. That illustrates the salutary effects of air and dilution on sewage. If you have to examine a river containing sewage matter, you can get very different results according to the place from which you take the samples. A sample taken near the edge of the river, where the sediment collects and foul gases are likely to be evolved, the water will probably exhibit only the lowest forms of organic life, but if the water taken in the middle of the stream, where air has free access and the water is abundant, the higher forms of infusoria will abound. You can tell in many cases by the character of the infusoria from what part of a river a given sample has been taken. Again, as regards river water, the only way to get a fair sample is to take a series of samples across the river from the one side to the other.

In the sediment, besides a great deal of black amorphous matter, there will be found—(1) the remains of undigested food, muscular fibre, husks and hairs of wheat, fibres of wool, and tissues of vegetables; (2) the products of secretions, such as yellow biliary matter, intestinal mucus and crystals of uric acid; (3) the debris of the streets, such as particles of granite, flint, carbonate of lime, etc. There are two things, however, which are specially characteristic of sewage. It is very important to know them, because their presence or absence will enable you to say with certainty whether matter found in a water is of sewage origin or not. You will almost certainly find hairs of wheat and free spirals—that is, vegetable spirals without their investing membrane. In the case of vegetable tissues passing through the alimentary canal, the fluids of the digestive tract have the power of dissolving the investing membrane, but not the spiral. Nothing that I know of is so characteristic of sewage as these free spirals and hairs of the wheat.

And now comes the question, What are we to do with the sewage? The voice of authority is not very unanimous on this question, but authorities are fairly well agreed on two points, (1) that if sewage contains anything of value to the agriculturist it is in solution,

and (2) that the matters in sewage likely to cause a nuisance, are in suspension. What is the value of sewage? Has it any value? Of course it has, you answer. It contains nitrogen, phosphoric acid and other constituents valuable to the soil. The calculation of its value is very easy to some people. You have only to find out what is the population, and then determine the quantity of the sewage. Taking the value of the excreta at six or seven shillings per head, of course (they will tell you) you have all the data you want for the calculation.

Years ago, when the population of London was only about 3,000,000, some very wise people said the Metropolitan sewage was worth from one to four millions sterling. That they were rather wide in their estimates is certain.

Suppose a local authority consults you about their sewage, the first thing they will do will be to refer you to the teachings of science. They will tell you that it is our duty to return to the soil those matters that have been taken from it—that it is a shame to waste sewage. No doubt they are right. But the authorities will press you further. They will ask—Can you tell us how to make our sewage pay the rates? Science has told them that the proper way is to apply it to the land, and they ask you to advise them how to do it advantageously. Having already discussed this branch of the subject at the Society of Arts, I only now note, *quâ* irrigation—1st, That the real value of sewage is not its theoretical value; and, 2nd, That there are definite obstacles against the application of crude sewage to land. Sewage comes to the works at all times—day and night. Sewage is no Sabbatarian. It must be taken Sunday and week day—in all weathers—in the heat of summer when the ground is liable to crack, and in time of frost when the ground becomes so hard that nothing can permeate it. You must take the sewage whether the ground wants it or not. You must take it in all conditions of your crops—in seed time and in harvest—all the year round. But another difficulty presents itself—namely, rival interests—call it, if you will, the antagonism of parties. The farmer naturally wants to make something out of the sewage. The local authority says to the farmer—I don't care whether you do or do not make anything out of it, but two things we demand—1st, That no nuisance shall result during the operation; and 2nd, That you should produce a pure effluent. Now, you see why local authorities, in order to obey the teachings of science, are compelled to be their own land proprietors. But now a fresh series of difficulties present themselves—1st, The soil must be porous enough for sewage to filter through it, but not too porous, lest the sewage pass through without purification; 2nd, The land must be sufficiently near a town to ensure a market for its only merchantable produce—Italian rye grass—but not so near the town as to pollute the air with miasms, or infect the wells by subsoil drainage; 3rd, The land must be of such a level as to receive the sewage by gravitation, but also of such a level as to allow the effluent to flow away from it by drainage.

The question of the land is in itself one of enormous difficulty. The more sewage you have to treat the more land you require, whilst as the population of your town increases, the difficulty of obtaining land also increases, and the higher becomes its price. But suppose science wins the day, and the land is procured and the sewage turned on. The results, next to certain, will be (1st) that your land becomes a fetid swamp—an offensive morass, and (2nd) that a nuisance results dangerous to the public health. If you may put sewage on land—undefecated sewage, I mean—with impunity, what is the good of all our elaborate

machinery for getting rid of sewage from our houses, and for preventing the escape of noxious emanations? If the principle of broad irrigation is sound, why should we bother ourselves about untrapped drains or overflowing cesspools? The sewage matter may percolate through the soil. Then how about the neighbouring wells? Did not Dr. Frankland think a certain chalk well at Croydon was polluted by foul matters from the irrigated farm at Beddington? Pettenkofer may be right, too, in regard to his theory that fluctuation in the levels of ground water is an active agent in the production of fever and cholera. I omit all reference to the question of the deterioration of the land by constant irrigation, and the difficulties resulting therefrom. But, it may be said, you admit that you may get a good effluent by irrigation. Well, suppose I admit that you may get a better effluent by such means than by a precipitation process. Still, that does not go very far. Let me give you a warning. Suppose an inspection of a sewage farm is arranged. The effluent water, you will be told, and will see for yourself, is not only pure but drinkable. I grant that under proper management you can rely upon obtaining good results. But that is not the question. Are such results obtainable at all times, and under all circumstances? I reply they are not, because they depend on too nice an adjustment of the quantity of the sewage and the weather. The nice balance requisite is not susceptible of mechanical adjustment. You cannot turn a screw and lay on the proper amount of sunshine. Local authorities, I have found, always like to have due notice of inspections of sewage farms, and that such appointments should be made subject to telegrams. Let me draw this conclusion. Do not give any notice when you propose inspecting a sewage farm. And when you go it is advisable to inspect the whole district. It is not at all uncommon to find very convenient byways for the disposal of sewage, which the land will not take.

I think you will now see why the difficulties of irrigation have led to the proposal of other methods of treatment. The solid matters, it is agreed, are the chief cause of nuisance, and these must be got rid of. I suppose the idea of making money, or of paying the rates out of sewage, is nearly given up. But in order to get the solid matter out, I say at once, you cannot stram sewage and you cannot filter it. The most effective strainer soon gets so clogged with aluminous matter that it fails to act. Subsidence or filtration methods equally fail.

Then you turn to chemicals. What are the points to be considered in the chemical treatment of sewage? They may be stated under five heads:—

1. That, consistent with good results, the chemicals should be cheap.
2. That they should act, not only as precipitants, but as deodorisers.
3. That it needs to be decided, by experiment, what is the minimum quantity of chemicals required to produce the maximum purity of effluent.
4. That the precipitated matter should subside rapidly.
5. That the sludge should part readily with its water.

Now comes the question, What chemicals are we to use? I have no patent. I never took out a patent in my life, and I don't mean to do so. I have no system to advocate. One system may answer best in one place, and a different one in another. Prof. Dewar and myself, it is true, have been called upon to report on the A B C process, as we have on other systems, and it is right that I should say for him and myself that our obligations entirely ended with the

report. I am not here to advocate the A B C or any other process. Further, I have no precise answer to give to the question of what chemicals to use. A precipitation process advisable at one place, may not be the process to be recommended at another. It is of no use to tell an authority at A to see how a process works at B, as if it would therefore work well at A. Nothing is a greater nuisance than show chemical precipitation works. A chemical adviser must have no hobby, or if he has, must be prepared to sink his hobby when the conditions are against him. With regard to the value of sludge, I advise that we give no scientific authority in support of any value. The enemies of precipitation schemes have been the advocates of sludge value. The public weighed the claims that have been advanced against the facts, and came to the conclusion that there was not much in the claims. Sludge may have a value, but it is one that chemistry is not able to take cognisance of. I may here quote an opinion expressed in the report by Professor Dewar and myself on the A B C process already referred to:—"As to the manurial value of native guano, we are strongly of opinion that this must be judged rather by the practical results of agriculturists than by presumed theoretical values based on analytical data, and on the price of ingredients not necessarily in the same physical or chemical condition."

To test a chemical process, it is of no use trying experiments on a small quantity of sewage like a tenth of a gallon. The smallest quantity that will be of use for the purpose is about five gallons. One of the first precipitants suggested was lime. Taking the sewage of a large town (not London), where I had to investigate the precipitating action of lime (it was a town where the sewage was about 30 gallons per head of population), I found that 20 grains of lime per gallon not only removed all suspended matter, but also one-fourth at least of the dissolved organic matter. The precipitate settled from 6 feet to 2½ inches with this quantity of lime in about one minute. The effluent had no smell. I am free to admit that there are great objections to the use of lime. 1st. When used in sufficient quantity the sludge is very large in amount and very valueless. If too little lime be used, its use is worse than useless, because a small quantity of lime renders the sewage ten times more offensive. 2nd. When lime is used the effluent is alkaline, and is accordingly liable to putrefy. 3rd. Free lime is injurious to fish life. I know of places where lime can be used, but it is not, I am convinced, universally applicable.

The second precipitant to which I may refer, is a salt of alumina. We know that compounds of alumina fix ammonia and phosphoric acid. Further, alumina combines as a mordant with organic matter in solution. The flocculation of sewage, treated by alumina, is very great. I have obtained excellent results from alumina, but the precipitation is slow.

Salts of iron are undoubtedly valuable both for precipitation and purification. They were suggested by Frankland and Hoffman for London sewage, and the reason why it was condemned was that a great deal of black deposit would result, which collecting on the banks would lead the people to think that the river was foul and would necessarily smell. The use of salts of iron makes the sludge very black from the formation of iron sulphide. Iron salts are not so good as sewage precipitants as sulphate of alumina. There are numerous other processes in which chloride of lime, magnesium salts, etc., are used, but most of them depend on one or other of the precipitants I have named.

Now, there are two points which in dealing with sewage it is desirable we should bring clearly

before local authorities. 1st. We can't produce a sludge having the value of Peruvian guano; and 2nd. We can't produce an effluent sufficiently pure to be employed as drinking water. As regards value of sludge, I discard at once all processes where phosphoric acid in any form is used to enrich the sludge by the formation of phosphates. Phosphates in an effluent are objectionable because they enormously assist the development of sewage fungus. Taken altogether, I am disposed to think that the use of an amount of lime sufficient to render the sewage alkaline, and the after addition of a salt of alumina, produces the best result.

The chief points to be attended to in the treatment of sewage by chemicals are:—1st. That the sewage should be treated fresh—*i.e.*, before actual putrefaction has set in. If within 24 hours, so much the better. The various organic matters in sewage possess different degrees of putrescibility. Fresh sewage has very little smell. Straining the sewage in the first instance with such mechanical contrivances as Baldwin Latham's extractor, has its advantages, but is not essential. 2nd. Sufficient chemicals should be added to effect complete purification. It is a great mistake to starve the chemicals. Local authorities are always ready to starve chemicals. They will build works, and spend large sums of money upon them. Works are something to look at and to admire, but when it comes to spending a considerable sum every week and every day in the treatment of their sewage, then comes the rub. Local authorities must be taught that, if they are to treat sewage properly, it means an every-day expenditure. With regard to the calculations, it is better to take population as the basis of the calculation of the quantity of chemicals needed rather than quality of sewage. 3rd. After you have added your chemicals, you must stir the mixture thoroughly if you wish to obtain the maximum result of the chemicals. You all know the value of the stirring rod. 4th. A very important matter is sufficient tank accommodation. Large tanks, or enough tanks, are necessary in order that the flocculent matter may subside perfectly, and that the sludge can be easily and frequently removed. If you have a quantity of old sludge in the tanks it putrefies and contaminates your freshly-treated sewage. It is not sufficient merely to empty the tanks, but you must wash them. It is a very hard thing, in my experience, to teach local authorities these things. It is very hard to teach them that they must not only have good works, but that the good works to be efficient must have constant attention. When all this has been done, two important questions arise: 1st. Have you produced an effluent that will not pollute the water course? and 2nd. Is not the sludge an inevitable cause of nuisance? In regard to the first, I answer, a precipitation process will produce such a good effluent, and that it may be made efficient at all times, but I know of no precipitation process by which you can remove entirely a certain peculiar odour of the effluent. There is always some smell left, and I don't know what it is. It will be asked—Can we do anything to get rid of this peculiar smell of a chemically produced effluent? There is only one thing to be done—*i.e.*, to let it flow over a little piece of land or through properly prepared filters. This constitutes the combined system of treatment. It cannot, as a defecated effluent, cause a nuisance. A very small quantity of land is sufficient. I have seen it done effectually with an acre to 10,000 of the population. As to the sludge being an inevitable nuisance, I think it need not be. Formerly it was, no doubt, a great nuisance; I am not sure, in fact, that the solid matter was not a greater nuisance when

taken out of the sewage than when left in it, but by the process of pressing the sludge now in use, you can remove its obnoxious character altogether.

Very excellent papers have been read in this room by Mr. C. C. Hutchinson and Dr. Monro upon this subject. Many very important facts were referred to in these papers, but there is one to which they did not refer. The liquor that is expressed from the sludge is clear and bright, but uncommonly offensive. The old method was, to return the expressed liquor to the raw sewage, but that inevitably renders the remainder of the sewage difficult to treat. The best way of dealing with expressed liquid is to treat it separately with a rather large dose of chloride of lime and then afterwards add lime.

I told you when called to advise upon a sewage process not to volunteer too many opinions. You will be asked to analyse a sample of effluent. I advise you to do no such thing. Take care to have half-hour samples of effluent, and take care, moreover, to have with the samples of effluent a sample of sewage taken similarly in order that you may compare the analysis of the raw sewage with the effluent with precision.

We have got ourselves into a terrible mess with this water-carried sewage. The advocates of the water carriage system tell us that water as a means of getting rid of our sewage difficulties commends itself on the ground of cleanliness and cheapness. I admit that, at first sight, all the advantages and all the arguments seem to be on one side, but I am disposed to think that the facts are for the most part on the other. Of the thirty gallons of water per head, brought at a vast expense daily to our homes, only about one-ninetieth part is used for drinking, much of the remainder being required for the carriage of the sewage. The water carriage system is an ingenious contrivance to occupy the time of local authorities, to increase the taxes of the people, and to assist the practices of chemists, counsel, and engineers.

After offering an apology for having detained the meeting so long, Dr. Tidy concluded with an eloquent appeal to men of science to address themselves to the study of this question. The sewage question, he said, is emphatically a question for the chemist. It is a question for those who, admitting the grandeur of scientific research, when it is research and when it is science, are yet not unmindful of the fact that it is a part of their duty to apply their science to the daily requirements of daily life and to the common wants and common needs of our common humanity.

DISCUSSION.

The CHAIRMAN said, in listening to the very interesting and instructive address which Dr. Tidy had delivered, the reference to the schemes of inventors who, starting out with sanguine anticipations of profits, so often missed the hoped-for success, had awakened a reminiscence of his early days. His father had shown him a sample of Welsh ore containing a small quantity of gold, but it proved on examination that it would never pay to get it out. This circumstance strongly impressed his mind at the time, and perhaps he owed it to that incident that he had in later life kept aloof from visionary schemes. Dr. Tidy had brought the matter before them so clearly that they would be disposed, perhaps, to exclaim, What on earth are we to do with our sewage? He hoped that an interesting discussion would follow.

Dr. DUPRÉ said he had listened to the paper with a great deal of pleasure. He thought that if sewage wanted a good deal of stirring it had that night been

very thoroughly stirred. Dr. Tidy had treated the subject so fairly and judiciously that it would be a great sin to begin a discussion at that late hour. Those who knew most of the subject of sewage, would know how well its difficulties had been described, and that they might have been extended to more than the two points selected. He was glad to hear reference made to the idea of local authorities that sewage would pay the rates. Local authorities were always disposed and ready to lay the blame of every failure on the chemist. The first duty of the chemist was to dismiss from his mind all idea of making a profit out of the sewage. There was one difficulty which every man who had experience in the chemical treatment with sulphates and by filtration would have met with. It was where the effluent had to be discharged into a small quantity of water. It sometimes happened that a stream which might, perhaps, be called a river in winter, was in summer nothing but a dry watercourse. He expressed hearty concurrence with Dr. Tidy on most points.

Mr. GROVES could offer some little testimony in favour of the lime and alumina process. In the case he was about to refer to, lime, then sulphate, and then small quantities of chloride were employed, and the effluent was discharged over a bed of charcoal. It passed into a canal, and fifteen months after the commencement of the works not the slightest deposit or disagreeable odour could be discovered. He thought that spoke strongly in favour of the process recommended by Dr. Tidy.

Mr. BISCHOP thanked Dr. Tidy for his interesting paper, but would like his opinion upon the increasing difficulty of disposing of sewage to the farmer caused by its fall in value. It was universally stated that a certain proportion of the value had to be taken off the process, and some people put the restriction at as much as five-sixths. Would not the value to agriculture proportionately decrease? Would it not be more and more difficult to get farmers to take the sewage, and would not local authorities be compelled to purchase land? He concluded by reading an extract from a letter he had received from the engineer of the Rochester (U.S.A.) Board, which recorded some excellent results of the system adopted in that country.

Mr. C. N. CRESSWELL was of opinion that the meeting owed a debt of thanks to Dr. Tidy for the fearless way in which he had expressed his views on a much-vexed subject. When Dr. Tidy stated that he had arrived at an important epoch in the history of sewage, he expressed an opinion with which he (Mr. Cresswell) entirely concurred, and he found it a very difficult thing to make a speech when he agreed with his adversary from the beginning to the end of his argument. He especially agreed with that portion of his address where he described the evils which we suffer from the water-carriage system. Some years ago, in a paper read before the Society of Arts, he described the evils resulting from the almost universal adoption of the water closet in rural districts, as well as in the towns. Nevertheless he had felt some measure of disappointment that they were asked not to discuss a measure which so much agitated the public mind at the present time—the question of Metropolitan sewage. The world of sanitary science had been startled by an alleged discovery, which, if true, was the most beneficent discovery of the age. They were told that Thames sewage could be treated by lime and salts of iron in such a way that for nine months out of the twelve they could get an effluent without danger to those who lived on the river and its banks, but that at certain times gaseous matters might be evolved which were offensive and

unsalubrious; that at length a means had been found which would enable the authorities of the Metropolis to overcome all their difficulties. They were told that permanganate of soda, with a certain proportion of sulphuric acid, would work that miracle. For the last forty or fifty years they had only known one method of dealing with sewage—applying it to the land. There was scarcely a community within 300 miles of London who had not spent a large sum of money on experiments in this direction; if the supposed discovery were true, it seemed a melancholy reflection that all their arguments and efforts must have been futile. When told that we were only in the infancy of the science, and that we must do nothing until we knew more about it, he had always thought it argued a dull and stolid mind; but if what they were now taught were sound, it went far to justify what was then called stupidity. It made those seem wise who had always said, "Don't let us spend thousands and thousands on these experiments, when, perhaps, in a few short years some inspired prophet of the day will relieve us of all our doubts and difficulties." It seemed to him (the speaker) of the greatest importance that they should be allowed to discuss a subject which so virtually affected the welfare of so many of the inhabitants on the banks of the Thames. Were they to continue to spend thousands of pounds annually in providing a proper outfall, or in the purchase of land, owing to their want of knowledge of the most fortunate discovery in this wonderful age?

Dr. Tidy then replied. He had had the pleasure of meeting Mr. Cresswell when their opinions were not in such absolute accord as they appeared to be that evening. They had been sometimes on opposite sides, and they, therefore, knew each other's views. In the address, he had carefully avoided the question of Metropolitan sewage, not because he had nothing to say upon the subject, but because he would rather deal with it as a whole. With regard to the alleged discovery which Mr. Cresswell had mentioned, he might point out that the three distinguished chemists who sent in the report containing the idea, had all given evidence that nothing more was wanted in the treatment of sewage. He wished to speak with all respect of those gentlemen, two of whom, Sir F. Abel and Dr. Odling, were old friends of his own; but he felt bound to point out that they had all given evidence before the Royal Commission that no treatment of sewage was required. He might claim to know something of the Metropolitan Board (having fought with them a fight lasting many days), and he could not help thinking that a Board which so completely agreed with this evidence, and who thought themselves great benefactors to the community in putting sewage into the Thames, were not perfectly justified in proposing to spend a sum of money in treating that sewage which was doing so much good. Mr. Cresswell, with his trained lawyer's mind, might perhaps divine what his (Dr. Tidy's) opinion was on the subject. He could only say that he considered it a very sad thing—he wished to speak generally—when processes were adopted which it was known must be a failure.

DR. SPRENGEL, F.R.S., exhibited some objects connected with the Hell Gate explosion, near New York—viz.: (1) Photographs (taken at the moment of explosion, 11.13 a.m., October 10, 1885) of the immediate surroundings of the mine, charged with 22 tons of dynamite and 107 tons of one of Dr. Sprengel's safety explosives (*Jour. Chem. Soc.* 1873, p. 806); (2) A sample of this safety explosive (79 per

cent. potassium chlorate and 21 per cent. nitrobenzene) possessing the power 109 (General Abbot, U.S. Army), dynamite No. 1 (containing 75 per cent. nitroglycerine) being 100; (3) Effects on lead produced by the explosion of equal weights of another series of safety explosives—the nitric-peroxide mixtures—demonstrating their greatly superior power over that of nitroglycerine.

Liverpool Section.

Chairman: E. K. Muspratt.

Vice-Chairman: Prof. J. Campbell Brown.

Committee:

Eustace Carey.
John Hargreaves.
E. Milner.
C. Symes.
F. Hurter.
H. Brunner.

A. Norman Tate.
J. Affleck.
J. C. Gamble.
Douglas Herman.
Alexander Watt.
E. G. Ballard.

Local Sec.: W. P. Thompson, 6, Lord Street, Liverpool.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held Wednesday, May 5, 1886, at
University College, Ashton Street.

PROF. CAMPBELL BROWN IN THE CHAIR.

THE CHAIRMAN called the attention of the meeting to the recent death of Mr. James Muspratt, father of the President of the Society, and moved the following resolution, which was seconded by Mr. A. Norman Tate, and carried unanimously:—"That the Liverpool Section of the Society of Chemical Industry has heard, with great regret, of the death of Mr. James Muspratt, and desires to offer its condolence to his family, and to record its profound respect for his memory, recognising the great work which he accomplished in initiating and developing chemical industry."

MR. ALEX. WATT exhibited a sample of Fahlberg's so-called "Saccharine," an account of which was recently given at the Manchester Section by Mr. Levinstein (see *Journal*, vol. v. p. 75).

THE CHAIRMAN hoped that the recent remarks of Sir Lyon Playfair would not render this substance too popular, unaccompanied as they were by even a word of warning. It must not be forgotten that this nitrogenous body was in no sense sugar, nor nutritious like sugar, although in some senses Sir Lyon Playfair might consider this a recommendation. Nitrogenous bodies were uncertain in their action, and were often poisonous without apparent reason.

MR. BRUNNER inquired as to the therapeutic action of saccharine.

MR. ALEX. WATT stated that it was held to be harmless.

THE CHAIRMAN required further evidence of this.

MR. TATE said that he was making an experiment, and would communicate the results to the Society.

DISCUSSION ON MR. T. ANDERSON REID'S PAPER ON "WOOD AS A PAPER-MAKING AGENT."

MR. NORMAN TATE said the Society was much indebted to Mr. Reid for his very practical paper, which showed what might be done, as a matter of chemical industry, in dealing with what would be

otherwise waste matters. He would like to ask whether the "teasing" process was simply a mechanical process, or was the wood in any way treated by chemical agents? On examining a substance made from wood pulp a short time since, he found in it small amounts of resinous and other matters which existed in natural wood. The substance was in the form of very thin sheets, and had apparently been made by rolling wood pulp, and subjecting it to very great pressure, until something similar to Kamptulicon and other floor coverings was obtained. An important suggestion made by Mr. Reid was, that during the recovery of the soda by evaporation, drying, etc., the volatile matters that were now wasted might be collected. In some places the recovery process had been so conducted as to become quite a nuisance to the neighbourhood in which it was carried on. In investigating the cause of this nuisance for legal purposes, he (Mr. Tate) noted that much of the strongly smelling volatile matter could be collected, but whether the character of the substances was such, and the quantity sufficient to pay for collection, he thought required further investigation. Many of the samples of marketable wood pulp he had examined contained as much as from 40 to 50 per cent. of moisture. He supposed there must be some reason based upon inferior texture of the pulp, if dried too much, that rendered it desirable that so much moisture should be left in, as the cost of carriage was thereby much increased. With regard to the sulphite process it appeared not to act satisfactorily unless the wood was brought into a finer state of division, and knots, etc., removed; whereas the caustic process appeared to deal more readily, and in an efficient manner with all refuse wood. Against this it must be remembered that by the sulphite process the yield of pulp on the wood actually employed is greater than by the alkaline process. Therefore, it seemed to be necessary to consider how far extra yield compensated for the extra cost of the process.

Mr. REID, in reply to a question from Mr. Brunner, said that the pulp was bought as air-dried, and was found to suit the paper makers in that condition.

Mr. W. P. THOMPSON reminded the meeting that, at the time of the South Sea Bubble, a company was actually floated for grinding down chips into sawdust and rolling it into boards. The intention seemed to be nothing more than to make paper pulp and solidify it by heavy pressure. When the author stated that hard woods yielded more pulp than soft woods, did he mean by weight or by bulk?

Mr. REID: By weight.

Mr. THOMPSON continued: American rock elm had such a strong fibre that it was used by lumbermen to tie their rafts together. Basswood was softer, but seemed all fibre. He would like to know how these two woods compared for pulp making. His idea was that basswood would give a larger quantity, and rock elm a stronger quality of fibre. The resins might be removed before bleaching by a treatment with hydrocarbons or carbon disulphide.

Mr. REID replied that the soda process saponified the resins, but the sulphite process rather tended to fix them in the form of an orange stain.

Mr. THOMPSON suspected that the pulp which Mr. Tate had found so resinous was a sample sent from Norway for a particular purpose, in which the resin was to serve as a kind of cement when the pulp was pressed into heated moulds. Blocks and medallions of imitation wood were often made in this way, surfaced with a veneer, or moulded into the appearance of carving. The veneer might even be of metal, and would firmly adhere to the pulp if a layer of glue

were interposed. He was not sure if this class of resinous pulp was ever used for paper making.

Mr. REID: The mechanical pulp which came from Norway and Sweden was only worth about £5 a-ton, and was quite useless for paper making, while chemical pulp was worth from £16 to £20 per ton.

Dr. HURTER, while regretting that they had not been furnished with some figures to illustrate the comparative cost of the alkali and sulphite processes, said that the cheapness of sulphurous acid, as compared with soda, would always be an inducement for them to try to render the former effective. It was evident that the sulphite process was not all that could be wished, or Messrs. Cross and Bevan would not have tried to combine it with the use of alkalis. If, for instance, pulp prepared by the sulphite process were incapable of being bleached, as had been stated, then none of the higher classes of pulp could be made by it. He was much interested in the author's remarks about the recovery of alkali in the soda process, because the recovery of 90 per cent. of the alkali would materially reduce its cost. It would be a further inducement to use the process if other products, such as acetic and oxalic acids, which were worth many times the price of alkali, could also be removed by subjecting the residue to dry distillation.

The CHAIRMAN quite agreed with the remarks which had fallen from the various speakers. It was true that the recovery of alkali from these processes was often accompanied by a disagreeable smell, but it was quite easy to prevent this by thorough combustion. At the same time the possibility of recovering valuable by-products must not be overlooked. He would like to point out that, for the class of resinous bodies present in wood, alkali was a far better solvent than bisulphide of carbon. As to the question of oxalic acid, one must remember that the object of the pulp maker was to free the cellulose as much as possible from extraneous matters without destroying the cellulose itself. If much oxalic acid were formed, it could only be at the expense of the cellulose itself, and would hence cause loss to the paper maker. Action on the cellulose was more likely by the soda process than by the sulphite process, and would account for a smaller yield of pulp in the former case. As regarded distillation products, they were quite as likely to be valuable whether derived from the deposits on the cell walls, or the cellulose itself.

Mr. THOMPSON stated that he had recently seen samples of artificial cork which looked very much like mechanical pulp with the resin taken out, and were of a pale yellow colour.

Mr. REID said that ordinary bark when treated with alkali gave a body like that described by the last speaker.

Manchester Section.

Chairman: Sir H. E. Roscoe, M.P.

Vice-Chairman: J. Levinstein.

Committee:

R. F. Carpenter.
C. Estcourt.
H. Grimshaw.
R. W. Gerland.
Peter Hart.
T. Jackson.

D. B. Hewitt.
C. Schorlemmer.
Watson Smith.
L. Siebold.
Wm. Thomson.
D. Watson.

Local Secretary:

J. Carter-Bell, Bankfield, The Cliff, Higher Broughton, Manchester.

MEETINGS, SESSION 1885-86.—First Tuesday in each Month, at 7 P.M.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

ALDERMAN W. H. BAILEY IN THE CHAIR.

NOTE ON MR. PETER HART'S PAPER ON CAUSTIC SODA.

BY GEORGE E. DAVIS.

I SUPPOSE it is universally admitted that caustic soda came into existence by reason of several manufacturers requiring to produce a highly carbonated soda-ash. The old-fashioned way of making soda-ash was to boil down the crude black-ash liquor in what was called a dandy-furnace, thereby producing a soda-ash containing about 48 to 50 per cent. of alkali, of which from 8 to 10 per cent was in the caustic state. This article was not suitable for many industries, notably wool scouring, and many attempts were made to carbonate the caustic alkali, and by others to remove it. In those days, however, the demand for caustic soda was extremely limited; and, moreover, the alkali-makers of that day were strongly impressed with the idea that caustic soda was of such an extremely corrosive nature that nothing would withstand it. I have been told, however, that small quantities of caustic were made about the date mentioned by Mr. Hart at the St. Rollox Works, in Glasgow, but it is equally certain that the quantity produced was not very great. I think the credit for producing it in quantity should be accorded to Mr. Gamble, of St. Helens, who was the first to work out Mr. Gossage's process for the separation of carbonate and caustic alkali from the same liquors; the carbonate was fished out, and the caustic remained behind in the mother-liquor, which was eventually boiled down and fused in cast-iron pots.

With regard to the manufacture of white caustic soda, there is no evidence whatever to show that it was made, even in small quantities, before it was produced by Dr. Pauli and Messrs. Evans & McBryde, at St. Helens, in 1862. Even in that year, most of the good coloured caustic soda was made by the causticisation of soda-ash with lime, and it will be known to most of you that Messrs. Roberts, Dale & Co., of this city, excelled as early manufacturers of this article.



OBSERVATIONS AND SUGGESTIONS ON THE PRESENT POSITION OF THE BRITISH CHEMICAL INDUSTRIES, WITH SPECIAL REFERENCE TO COAL-TAR DERIVATIVES.

BY IVAN LEVINSTEIN, ESQ.

IN the year 1878, Professor Bayer, the discoverer of artificial indigo, made the following remarks in a speech delivered on a special occasion:—*

"Germany, which, in comparison with England and France, possesses such great disadvantages with reference to natural resources (raw materials), has succeeded, by means of her intellectual activity, in wresting from both countries a source of national wealth. Germany no longer has to pay any tribute to foreign nations, but is now receiving such tribute from them, and the primary source from which this wealth originates has its home, not in Germany, but in England.

"It is one of the most singular phenomena in the domain of industrial chemistry, that the chief industrial nation, and the most practical people in the world, has been beaten in the endeavour to turn to profitable account the coal-tar which it possesses.

The numerous German colour works purchase from England the greater portion of the products of the distillation of coal-tar, and they supply three-fourths of the world with the colours made from it. However, we must not rest on our laurels, for we may be sure that England, which at present looks on quietly while we purchase her tar and convert it into colours, selling them to foreign nations at high prices, will unhesitatingly cut off the source of supply as soon as all the technical difficulties have been surmounted by the exertions of German manufacturers, etc."

Eight years have elapsed since these remarks were uttered, and what is our position in England to-day? We have not cut off from Germany the source of supply; we still supply Germany with three-fourths of the hydrocarbons which she requires; and we still allow Germany to supply us with at least three-fourths of the colouring matters which we use.

It might be argued that, after all, trade is in principle only an exchange of commodities, and as long as we supply Germany with the raw material, and it pays us to purchase from her the colours manufactured from it, there is no ground for complaint. This sounds plausible, and the assertion might be true if we got twenty shillings in exchange for a sovereign, or if the profits realised on our raw material were equal to those obtainable by turning the latter into finished products. But neither of these positions is correct. Our tar distillers are by no means so favourably situated as the German colour manufacturers. Instead of getting twenty shillings in exchange we do not even receive five shillings in return for our sovereign, and yet the natural advantages are all on our side.

Some little time ago an attempt was made to fulfil, in some measure, the prognostications of Professor Bayer, not exactly by cutting off the source of supply, but by endeavouring artificially to inflate, or at least control, the prices of some of the most important hydrocarbons; but experience taught, in this case as in all previous instances, that such attempts, however successful they may appear for a short time, end, as a rule, sooner or later, in heavy losses to the promoters and disaster to the participants. Trade does not admit of coercion; it must expand on natural bases. And there is only one sound way of stopping the supply to competitors of our raw materials, and that is by using them ourselves, and thus turning them to profitable account. Only thus can we secure to ourselves their full value, and benefit not only the industry more directly concerned, but also other collateral industries.

The productive capacity of the United Kingdom in benzene-toluene may be put down, without reckoning gas benzene, at nearly 3,000,000 gallons, of which quantity Germany takes about half—namely, 1,500,000 gallons, England half a million, the remainder going to France, Switzerland, and other countries, or constituting, as at present, floating or surplus stock. The home production of Germany and France does not exceed one million gallons, about equally divided between the two. Of the half-million gallons required by this country, only about half is converted into colouring matters, the other quarter of a million is exported as aniline-toluidine, pure aniline, or aniline salt. The entire consumption of benzene-toluene in Germany will be about 2,000,000 gallons per annum, of which only half a million is of home production. Of these two millions, about 1,600,000 gallons are converted into colouring matters, the remainder is turned into other tar derivatives; so that Germany requires four times the amount of benzene that we do, and she has to depend on ourselves for three-fourths of her supply; but when we consider the

* Ueber die Chemische Synthese. Festsrede bevor der Akademie der Wissenschaften zu München, am 25 Juli, 1878.

quantities of benzene-toluene actually converted into colouring matter, we find that Germany produces more than six times the amount of colours that this country does.

There are carbonised for lighting gas in this country at the present date about 12,000,000 tons of coal, yielding about 144,000,000 gallons of tar, or nearly 3,000,000 gallons of 50 per cent. benzene. The carbonising of coal for producing lighting gas increases per annum at the rate of 5 to 7½ per cent., while the consumption of benzene-toluene has remained about stationary for the last few years. This is partly owing to improvements in the manufacture of coal-tar colours, whereby larger yields of colouring matters were obtained; partly to a decreased demand for aniline and aniline salt by calico printers; partly to the fact that some benzene colours have been replaced by others. It is therefore apparent that there must be at present a larger supply than demand, and this accounts for the extraordinary low price of benzene (90 per cent. benzene being worth to-day only 1s. 8d. per gallon, against 14s. per gallon in 1883: *vide* "The Development and Present State of the Alizarin Industry," *Journ. Soc. Chem. Ind.* 1883).

On the other hand, the price of gas-tar, which was then about 45s. per ton, has come down to such a low price—namely, 7s. per ton—that some gas works have already begun to burn it in preference to selling it to the distillers. If the burning of tar should extend, its effect will be, no doubt, shortly perceptible in the rise of benzene: but we need not be afraid of this article ever reaching anything like the fancy price of 1883, unless new products are discovered in the manufacture of which it may largely enter. The existing carbonising plant for extracting benzene from gas will be the safeguard against any sudden inflation in the price of this article. Most of the carbonising works have now stopped operations, but a rise of 90 per cent. benzene—say, to 3s. 6d. per gallon—would soon see them again in full work.

Besides the benzene-toluene, Germany also imports from England from four to five thousand tons of anthracene, some naphthalene, xylene, etc., and in order to convert these hydrocarbons into colours and other tar derivatives, there are required annually upwards of 70,000 tons of concentrated sulphuric acid, twenty-five to thirty thousand tons of carbonate of soda (100 per cent.), which was nearly one-third of the total quantity of soda produced in Germany in 1883, and 40,000 tons of hydrochloric acid, beside large quantities of acetic acid, ammonia, nitrate of soda, nitrite of soda, salt, etc. The consumption in 1881 of the principal manufactured raw materials by one large German colour works alone was as follows:—

Sulphuric acid.....	20,000 tons
Soda (90 per cent.).....	7,000 "
Hydrochloric acid	13,000 "

These figures will give you some approximate idea of how other industries have been benefited by the expansion of the tar industry, and we need not be surprised at the rapid increase of the production of sulphuric acid in Germany, which has more than trebled within ten years, for while in 1875 only 102,546 tons of sulphuric acid were produced, this quantity increased in 1884 to 345,138 tons, and an increase of a similar nature has taken place in the production of soda in Germany, of which the following information will give us some conception. According to the late Mr. Weldon, Germany produced, in 1883, of Leblanc soda 56,500 tons, and of ammonia soda 44,000 tons, while the production for 1885 is estimated at 30,000 to 40,000 tons Leblanc soda, 90,000 to 100,000 tons ammonia soda.

IMPORTS AND EXPORTS INTO AND FROM GERMANY OF CAUSTIC SODA AND SODA CALCINED AND IN CRYSTALS, FROM JANUARY 1, 1882, TO END OF DECEMBER, 1885.

	IMPORTS.			
	1882	1883	1884	1885
Caustic soda.....	6,577 ..	5,231 ..	3,615 ..	3,261
Soda calcined & in crystals....	19,233 ..	14,802 ..	10,141 ..	8,126
	EXPORTS.			
	1882	1883	1884	1885
Caustic soda.....	413 ..	1,271 ..	1,612 ..	1,316
Soda calcined & in crystals....	6,299 ..	8,049 ..	15,721 ..	17,302

The above quantities are in tons.

From this we not only see that the production of Leblanc soda in Germany has been reduced, while that of ammonia soda has been much increased, but also that the imports of caustic soda and carbonate of soda have been steadily decreasing, notwithstanding an enlarged home consumption, while the exports, especially of carbonate, have considerably increased, and in 1885 amounted to more than twice the quantity of the imports; that is, they had nearly trebled within three years.

We will now inquire into the natural advantages possessed by this country for carrying on the manufacture of coal-tar derivatives, and compare them with those of our great rivals, and in doing so, it must be premised that in making calculations and quotations Manchester has been selected as the British centre and Frankfort-on-the-Maine as the German centre, and in each case the prices are for delivery at the purchaser's works within a radius of about five miles from the respective centres. The following are the principal primary raw materials required in the manufacture of coal-tar colours, whether for the half manufactured or the intermediate products:—

1, The products of gas-tar distillation—viz., benzene, toluene, carbolic acid, xylene, naphthalene, anthracene; 2, ammonia; 3, coal; 4, salt; 5, lime; 6, pyrites; 7, nitrate of soda; 8, iron.

Now all these are natural products, and are obtained at a considerably lower cost (more or less) in England than in Germany. Those numbered 1, 2, 3, 4, and 8 are important articles of export from this country, as everyone knows, while Nos. 6 and 7 can be got here, on account of cheaper freight, at less cost than in Germany. To these advantages must be added our more favourable geographical position, our far larger home consumption of colouring matters, and also greater cheapness of building materials. I shall at once be told that the Germans have a complete set-off against all these advantages, in the shape of cheaper labour, and that their chemists are more skilful than ours. As regards the question of the comparative cost of labour, I concede that there is a difference between the wages paid to the men employed in chemical works in the two countries, but it (again taking Frankfort and Manchester) does not at the present moment exceed 2s. per head weekly. This difference in wages can be compensated, and matters equalised by a larger outlay of capital in the construction of general plant and of comparatively larger buildings, both of which—i.e., steam-engines, boilers, pumps, tanks, etc., and building materials, as well as capital—are cheaper here than there, and therefore would not and do not ultimately increase the general expenses of the manufacturer. But apart from this, it does not require much foresight to predict that ere long—with the fiscal policy of the German Government, which is steadily causing an increase in the cost of living, and must necessarily bring about a corresponding rise in wages, while the opposite is taking place in this country—the question

of the actual cost of labour may change if anything to our advantage.

And as regards the assertion respecting the superior chemical skill of the Germans, this principally applies to the bringing out of new products, but not as much to the manufacture of articles the chemistry of which is well known, and here I must notice some changes which have taken place during the last few years. A number of foreign patents have run out by lapse of time, or from other causes. The chemical constitution of by far the largest number of colouring matters in use is well understood, and the technical difficulties connected with producing them in the most economical manner have been overcome, so that we may safely say, that at least 75 per cent. of our benzene-toluene and 90 per cent. of our anthracene exported might be converted into colours by British manufacturers without the aid from any chemist of special genius. In alluding to the manufacture of these coloured tar-derivatives, in connection with which superior knowledge on the part of the Germans can no longer be argued, it is very far from my intention to harbour the thought that we should be merely imitators of them. I only refer to the fact that for turning the greater portion of our raw material to more profitable account, no special chemical genius is required, and if even for this work our chemists are not yet sufficiently trained, we must secure the services of clever experimental chemists wherever we can find them, and this is no longer so difficult as formerly, as the number of specialists in this department of science who have received a high training in the universities of our competitors is constantly increasing, and at the present rate will, if anything, shortly exceed the demand.

It is true that the production of colouring matters in this country, excluding alizarin, has increased, still the increase, which may be due to the manufacture of some specialities, is not only not nearly what it might and should be, but disappears to some extent when we take into account the greatly increased production of coal-tar derivatives, clearly shown in the following figures:—

EXPORT FROM GERMANY OF COAL-TAR DYES, ANILINE OIL, AND SOME MANUFACTURED INTERMEDIATE PRODUCTS OF THE COAL-TAR INDUSTRY. THE QUANTITIES ARE GIVEN IN TONS.

1882	1883	1884	1885*
3,828	4,181	5,178	6,358

The question then arises—if it is a fact that the natural advantages are all on our side, and if it is also a fact that lower wages and superior chemical knowledge in the manufacture of a large number of coal-tar derivatives can no longer be pleaded—What are the reasons why far greater progress has not been made in this country in the manufacture of these products? or, Do *other obstacles* exist to prevent us from taking full advantage of the lower cost of the primary materials? I, for one, contend that there are no real difficulties in the way of getting hold of the larger share of this business, if only the true position of this industry, its constantly growing extension, its daily increasing importance, and its important bearing on the development of other industries, were fully understood and appreciated by the nation, and especially by its enterprising capitalists. The development of industrial enterprise in this country has for the last thirty years been practically confined to cotton, wool, iron, and coal, to the lamentable neglect of other industries of ap-

parently minor importance, while the chemical industries have been left in the hands of a few, who—often more by good luck than through intelligent and economical management or scientific attainments, but aided by the natural wealth of the country—have carried on the business more or less successfully, whilst outside of these few the general public was in profound ignorance of industrial chemistry. Hence the total want of enterprise in this direction on the part of the nation, owing to an insufficient appreciation of the importance of the chemical industries; the consequent apathy, and the absence of any intimate connection or intercourse between our scientific men and our manufacturers; and, finally, the very great facility with which fortunes had been made in years gone by in what were then considered staple industries. All these combined were the primary and principal causes which fully account for our present position in regard not alone to the coal-tar industry, but to most other branches of chemical industry.

The position of Germany was quite different; in her case none of these adverse circumstances existed. There was no superabundance of accumulated wealth, nor the same easy opportunities of acquiring it, the great natural advantages did not exist, and a knowledge of chemistry was more diffused among the people, consequently new branches of chemical industry were eagerly sought for and energetically taken up by enterprising capitalists, supported by the people and the scientific men.

It is obvious that the unfortunate circumstances which have hitherto influenced and restricted our national industrial enterprise in certain directions must have exercised injurious effects not only on the development of the chemical industries, but also on that of other industries. This country possesses eminent engineers, whose names have a world-wide reputation, but we do not possess what may be termed chemical engineers, or at any rate they are very few indeed in number. For suggesting or discovering new chemical products or combinations we require chemists of talent, but for carrying out their suggestions to a successful issue, highly-trained chemists and chemical engineers capable of devising the necessary apparatus are also needed, and often the practical value of these suggestions depends largely on the skill of the chemical engineer. I apprehend that the expression, chemical engineering, by which I understand the conversion of laboratory processes into industrial ones, is by very few appreciated to the extent which it deserves, and the devising and constructing of plant and appliances in chemical and similar works is as a rule left either to engineers who are not conversant with the chemistry of the processes for which the apparatus is destined, or to the works mechanic, who simply proceeds by rule of thumb, or else it falls to an inexperienced chemist who understands nothing of engineering. The following illustrations may be useful in bringing before the minds of those who are not fully acquainted with this subject, the importance of chemical engineering. Many of you will have heard of the Mather-Thompson bleaching process; now there is nothing new in the chemistry of this process—indeed in 1855 Paul Firmin-Didot patented in this country a process for bleaching textile fabrics, etc., which, as far as the use of carbonic acid to decompose the bleaching lime is concerned, is substantially identical with the Mather-Thompson process. Now I believe neither of the two in their original conception were or ever could have been put into practice: it was owing entirely to the engineering skill of Mr. Mather, M.P., assisted by two technical chemists, that it has entered into a new phase and now promises to revolutionise the bleaching trade as

* This great increase in the export is principally due to the very much extended demand for the naphthalene derivatives.

hitherto conducted; the chemical part was merely subservient. The history of the ammonia-soda process offers quite as forcible an example of the importance of chemical engineering. In this case the merely chemical process was known and understood, nearly fifty years ago, and many years ago it had really been practically tried by some of our largest alkali makers, and abandoned as too costly even when alkali commanded three times the price that it does to-day; it was reserved for the ingenuity of the chemical engineer, Ernest Solvay, in 1866, to turn this process into a practical industrial one.

Now, gentlemen, in consequence of the development of the coal-tar colour industry in Germany, there have sprung up, *pari passu*, not only huge colour works, but also engineering and machine works, the speciality of which is the supply of all the necessary apparatus and plant required by this industry, and also the devising such apparatus for new processes, and they are thoroughly proficient in this class of work. Besides, in the immense workshops of the large German coal-tar colour manufacturing companies, a staff of scientific chemical engineers has been trained, to whom it is as easy to devise plant for practically carrying out the most complicated and novel chemical processes, as it is for any of our engineers to construct a bridge or carry out any other routine work; and it is a fact that there are chemical engineering works on the Continent, which either are the sole source for the supply of certain special plant required in the tar industry, or deliver apparatus of a better and at the same time cheaper construction than we can obtain here. It might be desirable to attach to our chemical laboratories, as a tentative, an engineering laboratory, where all sorts of appliances could be devised and constructed, and the conversion of laboratory processes into practical industrial ones could be effected.

There are some people who are opposed to the teaching of technical chemistry in its present form, and who contend that the only proper school for acquiring the knowledge of technology, or technical chemistry, is to be found in practice. In its present mismanaged form they may be right, when professors are placed at the head of our largest technical colleges who have never in their life done an hour's practical work in any manufactory or works, and whose only qualification appears to be *purely* scientific attainments. Now the occupier of a chair of chemical technology, or any teacher of that department of scientific knowledge, is, in my opinion, entirely out of place and simply useless as far as the teaching of this science is concerned, unless he possesses, in addition to his scientific attainments, practical knowledge acquired in some works, and further, unless he helps himself by constant intercourse with manufacturers, instead of keeping, as most of our professors do, carefully aloof from them. Industry and science must work hand in hand, for each can learn from and benefit the other. Chemists intended for technical work who are wanting in previous training in technology, of which chemical engineering is really a part, find on entering the manufacturer's works, that their time is so much taken up with a mass of mechanical details, with which they would, under other and better arrangements, have been fairly acquainted, that by the time they have mastered these, their previous knowledge of chemistry has suffered. It must also be palpable that a chemist intended for industrial work, who along with a sound training in chemistry has also acquired a fair knowledge of chemical engineering, must be better fitted for his work than the man who is only practically acquainted with the handling of china basins, phials, and a Liebig's condenser.

In the year 1883 I had the honour of delivering

before our Section at this College two lectures on the development and actual position of the alizarin industry, and I then invited our manufacturers to establish or at least extend this industry in this country, and among other things I pointed out the natural advantages which we possessed to make its establishment a commercial success. Since then the English production of alizarin has considerably increased, for whereas at that time we scarcely supplied one-tenth of the home market requirements, to-day one third or nearly so of the alizarin used by our dyers and printers is of English origin. Some of you will perhaps remember that I also stated that 20 per cent. alizarin, which was then worth 2s. 6d. per lb., would shortly come down to 1s. 3d. I well recollect that by many this prediction was received with incredulity, and by others, more interested in this matter, even ridiculed. Well, gentlemen, not many months afterwards the price was reduced to 1s. 3d. per lb., while the average price of this article to-day is 9d. per lb. It is true that some of the materials used in its manufacture are at present lower than formerly, but 9d. per lb. does not just now leave the producer a legitimate profit. It would take too long a time to go fully into the question of how this enormous fall in price was brought about, but I will briefly mention the principal cause, in order that we may all clearly understand the position of this industry at the present moment. It will be in the recollection of some of you, that before the patent had run out in 1883, there existed a combination of the alizarin makers in Germany which had resulted in running the price up to such an extent that between them they cleared in one year about one million sterling. This combination—after issuing the famous circular threatening to stop the supply to British consumers unless they agreed to extend their contracts at this fabulous price for twelve months beyond the time of the expiration of the patent—continued to subsist, and might still, for all we know, have been in existence if the establishment of the alizarin manufacture in this country had not put an end to it. It is the development of the alizarin industry in this country that our printers and dyers have to thank for a cheap and unlimited supply of alizarin. It was the development of this new industry which the combination attempted to crush in the germ, and this fact accounts for the present unremunerative price; and this endeavour on the part of some powerful Continental colour-manufacturing companies to crush British competition by hook or by crook is not the only instance of such action. Now, some may say that with all this reduction in the price of the article, our dyers and printers are not one iota better off to-day than they were when it was much higher. I would just invite such persons to consider what their position would have been if the combination had not been broken up. Turkey red dyers, printers, and merchants, each and all of them would have been at its mercy; and if it had so pleased the German combination, it might even have altogether stopped our export trade in Turkey-red or alizarin dyed goods by exacting prohibitive prices from our consumers, and thus diverted this important branch of the dyeing and printing trade also into the hands of German manufacturers and merchants. Well, gentlemen, this combination has fortunately ceased to exist. There is at present an over-production of the article; its price will therefore continue for a while at a low point, but it will scarcely go lower, for already one of the largest German works has had to admit having suffered heavy losses from its manufacture, and others are not in a more favourable position. We may therefore safely assume that whatever the intention may

be on the Continent in reference to this industry, those manufacturers will not continue for any length of time to produce the article at a loss. Now, I would advise our manufacturers of alizarin, who, in consequence of the manoeuvres of their foreign competitors, are not at the present date realising legitimate profits, to stand firm, to use their best efforts in further improving their plant, thus saving manual labour and economising fuel, and to trust to the exertions of their countrymen to do away with the present anomalous position of the alkali and acid markets, and then they will again realise the profits which are due to them for their pluck and energy, and be enabled to bid defiance to any foreign competition whatever. Great changes have taken place

The export of alkali from Great Britain does not give the true position of the Leblanc soda manufacture. In reviewing the following table, the export has been about stationary for the last three years, but it must not be overlooked that it includes ammonia soda, and that there is annually a largely increasing consumption of soda, which the capacity of the existing ammonia soda works cannot yet supply. On the other hand, it must also be taken into account that the erection of new ammonia soda works and the enlargement of the existing ones, is rapidly proceeding on the Continent, and to this fact is no doubt already due the decreased export of alkali from this country to Russia, Germany, Holland, Belgium, and France.

EXPORT OF ALKALI

	1883.	1884.	1885.	
	Tons.	Tons.	Tons.	Cwts.
To Russia	25,005	24,215	23,036	6
Germany (Austria and Hungary included) ...	36,095	28,230	23,702	11
Holland	15,845	14,300	11,077	10
Belgium	7,735	5,565	5,305	5
France	7,655	5,675	5,443	2
Spain and Canaries	12,415	14,385	12,811	16
Italy	11,420	13,540	13,210	5
United States	172,070	156,015	167,081	14
Other Countries	59,410	66,195	68,349	7
Total	347,350	328,120	333,080	16

since 1883. We no longer have to record any advantage in the prices of soda or sulphuric acid. That which seemed most improbable has actually happened, and, startling as the assertion may seem to you, the scale has been turned against us. The German manufacturer can now purchase sulphuric acid very much cheaper than we can; caustic soda is no longer of the same importance as formerly, as many of the large German consumers find it to their advantage to causticise for themselves the cheap ammonia soda; and as for ammonia soda, the Germans, not satisfied with their triumph in having made themselves independent of this country, are actually exporting soda to Great Britain. If they cannot as yet show an advantage in price delivered in Manchester, because of the heavy carriage, they are already doing a fair business in this article in the London market and export trade. They are offering ammonia soda (98 per cent.) in London at £5 10s. per ton, while the price f.o.b. at Antwerp is £4 17s. 6d.

What is becoming of the industries of Great Britain? For more than half a century England ruled all the markets of the world for soda, her chief stronghold in the staple chemical industries is threatened, already her home market is invaded by the foreign producer. An important article of export is not alone in danger of being ultimately lost to us, but our strongest competitors in foreign countries can already purchase this all-important article more than 15 per cent. cheaper than we can in this country, and thus materially lessen the cost of production of a number of other articles. But this state of things is not confined to ammonia soda; 96 per cent. caustic soda, made most likely from the ammonia soda, is already competing in the Manchester market with our own make, and is even preferred to ours.

For the information of those who are not chemists, I may say that of the already mentioned primary raw materials, those required principally for the manufacture of soda (by Leblanc's or Solvay's process), and of sulphuric acid, are—salt, pyrites, ammonia, lime, coal, and nitrate of soda. All these primary raw materials, as already mentioned, are cheaper in this country than in Germany. Still the German consumers can purchase ammonia soda (98 per cent.) *delivered at their works* (again taking Manchester and Frankfort as the respective centres) at £4 7s. 6d. per ton, whilst the Manchester consumer has to pay £5 5s.—that is, about 15 per cent. more than his foreign competitor. This is a considerable difference and a great disadvantage to the British consumer, but he is in a still worse position as regards the price of sulphuric acid, for the price of this article d.o.v. 66° B \acute{e} . or about 170° Tw., delivered in carboys free at the consumer's works, at similar distances from the original manufactory, is at Frankfort £3 per ton, but at Manchester £3 17s. 6d. per ton. The prices delivered in tanks free at the manufacturer's works are of course in both instances considerably lower.

I have now disposed of the wages question, and of superior chemical skill, also the cost of building materials, but I anticipate the remark, that is all very well, but the Germans are simply going to ruin with such prices as these. A remark like this would, however, be out of place, as both these quotations—viz., for the soda and the sulphuric acid—are regulated by a convention, and until a few months ago the selling price of sulphuric acid was actually 10 per cent. lower than at present, and it is obvious that if this price did not allow a sufficient margin to the producer, the convention would not have been content with an advance of 10 per cent.

As to the high price of ammonia soda,—which is that form of soda which most especially interests the coal-tar manufacturer,—the explanation is a very simple one, while the causes which led to it, as well as to the extraordinarily high price of sulphuric acid, must be looked for in a similar state of things to that which placed us in such a singular position with regard to the coal-tar industry.

The manufacture of ammonia soda was commenced in this country in 1873, by Messrs. Brunner, Mond & Co., who had a license to use M. Solvay's patents, of which the principal ones expired some time ago. M. Solvay's process soon established its superiority over the only one then in use, known as Leblanc's, with the result that many works in which the latter was carried on had to be closed, and most of those which yet continue to use it are only struggling for existence. The hope was cherished by the Leblanc soda makers that an increased export and an advanced price for bleaching powder, which indirectly is a by-product of this process, would compensate for the falling off in the profits on the principal article of manufacture—viz., soda,—but both these assumptions do not appear to have been realised, as the following table will show:—

EXPORT OF BLEACHING POWDER.

	Quantities in Tons.			Value.		
1883	80,030	...	...	£480,278	...	...
1884	80,530	...	...	661,406	...	...
1885	75,407	...	...	507,345	...	...
				£ s. d.	£ s. d.	
The market value fluctuated in						
1883 from	4	7	6	to	9	10 0
Ditto 1884	9	10	0	„	7	10 0
Ditto 1885	6	10	0	„	6	5 0
The price for bleaching powder						
to-day is	5	12	6			

The dangers which now more than ever menace the existence of the Leblanc soda manufacture are, the possibility of utilising the by-product obtained in the ammonia-soda process in the making of chlorine; the great probability of a further reduction in the price of ammonia soda, which is already comparatively lower than the Leblanc soda; and last, not least, the new competition which has presented itself on the part of Germany. In a word, the Leblanc soda manufacturer seems placed in a dilemma in whatever way he regards his position. In my opinion there is only one way out of it, and that is that the less favourably situated manufacturers reduce the nominal book value of their present works, take advantage of cheap capital, cheap salt, cheap ammonia, and cheap coal, and erect ammonia-soda works on the best and most approved principles. There are a few manufacturers in this country who make ammonia soda, but their output is as yet quite insignificant, and unfortunately, as I think, they have adopted a system differing from that of which the efficiency had been proved. We are certainly yet depending for the supply of bleaching powder on the Leblanc soda process, but then its consumption is limited, and does not stand in any proportion to the productive capacity of our Leblanc soda works, which are now working on a restriction of about 40 per cent. on their output of bleach.

I am, however, not called upon to act the part of adviser to our alkali manufacturers, but it lies in the province of this paper to call attention to the effects of the want of enterprise in the chemical industries, and these are serious enough. An important portion of our staple industry is practically threatened with ruin, other industries are heavily

handicapped, while the development and progress of new industries are seriously impeded.

Only consider the disadvantage at which our bleachers, dyers, scourers, soap makers, woollen manufacturers, paper makers, and coal-tar colour manufacturers are placed with regard to their German competitors, who can purchase these absolute necessities at so much lower prices than we can. That the import and export trade in such an important article as soap must be affected by the higher prices of alkali is certain; and we find that while the export of soap was in 1884, 23,872 tons, it decreased in 1885 to 20,113 tons.

I am fully aware of the fact that many are still preferring Leblanc soda ash to ammonia soda, but this is a prejudice, and at the price at which the Germans can purchase the ammonia soda it will pay them far better to use the latter, and in the purely exceptional cases in which a caustic ash is required, it will be much cheaper to add to the ammonia soda a slight percentage of caustic soda, or to causticise a portion of the former.

We will now pass on to the consideration of the high price of sulphuric acid, and here the explanation is far more puzzling to arrive at. There exists no monopoly; on the contrary, I should think that at this moment plant is standing idle which is capable of producing 100,000 tons annually of sulphuric acid. Our vitriol makers (I am referring to those who only make sulphuric acid *per se*, and not to those who produce it for decomposing salt) contend that if they had to sell concentrated sulphuric acid at anything like the German price, they could not continue to carry on their business, and this in face of cheaper raw materials all round. The logical inference from this would be, inasmuch as the labour question is here also only of secondary importance, that the German maker must either be in possession of a superior process or better plant, or that by more economical management, by better organisation and discipline he obtains a larger yield, or perhaps all these suppositions are correct. It is, at all events, surprising that the northern alkali makers, with thousands of pounds' worth of vitriol plant lying idle, do not send some of their surplus stock into the Manchester market; one would think that the smallest profit would pay better than allowing the plant to deteriorate. The vitriol could be delivered in iron tanks, as is done elsewhere, and I do not doubt that there is a fair market for it at a reasonable price in this city.

It may be of value to some of our vitriol makers to know that the Griesheim Chemical Works, near Frankfurt-on-the-Maine, have turned into an industrial process Marignac's and Lunge's experiments, which were directed towards obtaining, by cooling to a low degree and crystallising, more concentrated sulphuric acid and monohydrate from weaker sulphuric acid. This new process has now been working for some time, and it is said to be very satisfactory both as regards cost and quality.* I was in hopes of being able to give you this evening further details; the necessary information, however, did not reach me in time.

I have so far attempted to bring before you the special advantages which we possess for the development of the coal-tar industry. I have endeavoured to indicate the causes which have led to the present position of this industry in this country, and also the injurious effects which its neglect has inflicted on other industries, and with your indulgence I will now briefly refer to our chances of removing some of the

* English Patent, No. 96, January 8, 1883; German Patent, No. 21,102; and also see Hasenclever (*Chemische Industrie*, No. 3, March, 1884, p. 83).

anomalies to which I have referred. The question of improved chemical engineering is the least important, at any rate for the present, as the extra cost of procuring *special* plant from Germany, disheartening as such a course may be, is fully balanced by the greater cheapness of *general* plant in this country.

The difficulty in the case of the ammonia soda is at present greater; here the only likely chances are either that our enterprising capitalists, or our present Leblanc soda makers, will bestir themselves, or if they cannot be moved, we must trust to the Germans; the fact alone that they have started to compete in ammonia soda may induce practically the only British maker of this article to reduce his present price. But there is still another feature in the case which may favour a reduction in the price of this article. The quantity manufactured in Germany already exceeds the demand, and it may pay the makers there to export it at a still lower price, or even at actual cost, in order to pay expenses, the profit being of course made on the sales in their own country, where they now have the full swing of the market.

The fast-developing ammonia soda manufacture in Belgium must also be taken into account, so that there is at any rate a great probability that the present high price cannot long be maintained.

As to sulphuric acid, if it really is a fact that our makers cannot sell this article with a margin of profit at the same price as their German competitors, they must either remodel their works or alter their process, and if they cannot be induced to do this, then let a few larger consumers of sulphuric acid combine and put up their own vitriol chambers in a convenient locality, adopting all the improvements, whatever they may be, of our rivals.

Now, gentlemen, these suggestions for the immediate removal of some of the obstacles which impede the progress of the coal-tar and other industries must not be understood as implying that, this being accomplished, we shall at once regain our former position in the markets of the world. What is wanted above all is to arouse our dormant enterprise, to wake up to the fact that our natural wealth, by itself, no longer affords us an easy opportunity of acquiring fortunes as in days gone by, and that the ever-increasing activity and energy of our rivals has actually deprived us of industries, for the carrying out of which we possess every natural advantage. Let every Englishman fully appreciate the fact, that the constantly growing importance and extension of the chemical industries, and the bringing out of new products, not only create new collateral industries, but also materially influence the development of those already existing.

After all, if the importance of any industry is once thoroughly understood and appreciated by the nation, and that nation possesses everything that is favourable to its development, there will always be men coming forward of sufficient talent to surmount any other difficulty, and once such an industry is fully established and commences to expand, all the other necessary requirements will present themselves.

DISCUSSION.

The CHAIRMAN, after alluding to the great benefit which papers like that which they had just heard, conferred, not only on Lancashire, but on the community at large, likened the author to one of the prophets of old, standing outside the walls of the city, and calling upon the people to arouse themselves from their lethargy. He had shown that, notwithstanding this country possessed raw materials, men, and money, yet it was losing valuable industries, and that even in its own special department of engineering it lacked adaptability and energy. They must

seek out the causes of this decay, and strive to regain their old supremacy.

Mr. WATSON SMITH called to mind the memorable words of the late Walter Weldon, F.R.S., in his address as retiring president, at Newcastle-on-Tyne, 9th July, 1884:—"It is not willingly that I have announced a new—and much more serious than any previous—menace to an industry already sorely tried. How much I should have preferred to have been able to prophesy smooth things with respect to the Leblanc process, no words can say. Facts, however, must be looked in the face. Nothing can be less wholesome than the atmosphere of a fool's paradise. And the watch-dog at the gate, who gives timely notice of the approach of unwelcome visitors, at least renders such service as is in his power." Two years had fled since these words were uttered, and now the voice of warning was again heard. Mr. Levinstein had, however, sounded an alarm extending not alone to the soda industry, but to other chemical industries; and whilst administering warning in no uncertain tones, he had striven to the utmost to apply wholesome counsel and advice. That Mr. Weldon was a prophet indeed, the clear statistics and logical sentences of Mr. Levinstein did testify, and though upon him the mantle of Mr. Weldon had fallen, his prophesying embraced a wider prospect, and the sound of it went forth in more ominous tones. A panacea for the evils in prospect was to be found in improved education, and naturally, what Mr. Levinstein had said with regard to teaching, was of principal interest to the speaker. He begged to endorse what had been stated as to the importance of teaching the scientific principles involved in the special construction of apparatus and plant for chemical processes on the large scale. It was part of the recognised course for a student of science to learn in those scientific workshops—the chemical and physical laboratories, the construction and use of apparatus. It was a scientific process, and one demanding even more judgment, experience and skill, to pass efficiently from the scientific laboratories to the manufacturing laboratories or workshops, and to convert apparatus for dealing with grains and grammes into that dealing with tons, and further—*dealing in the most economical manner*. Of all subjects connected with the branch of Chemical Technology, the inculcating and teaching of the principles of the economies of manufacturing operations, can least adequately be done by those teachers who have had no living and active experience in the manufacturing workshops. It was also hard to conceive any capacity for setting forth the principles of construction as adapted to apparatus for chemical processes on the large scale, except in cases where practical experience had been gained—and the more painfully, he was going to say, the better. He could well remember the day when, in the majority of cases, the free, unshackled exercise of chemical science by the chemist, was zealously excluded from the alkali and sulphuric acid works of this country, chiefly by those placed in authority as managers, to whom the authority of the chemist was as nothing, who practically trampled on his advice and subverted his doctrines, whose watchword as well as thunderbolt was—"Give me my ounce of practice and you can keep your ton of theory." Thus, and as a natural consequence, he well remembered that a man investing, *e.g.*, in a caustic soda plant, was more frequently than not almost ruined with batches of discoloured caustic ere he sailed into port from the wild ocean of "Rule of Thumb," with the newly-discovered "knack," of making it white. Relying too much on rich natural resources, as Mr. Levinstein had so well pointed out, the English chemical manufacturer had, in most cases, gone too much on the "knack"

principle, or rather—want of principle. There are many large scale chemical processes that must be carried on night and day, and from some considerable experience of the class of men put in charge of certain of these processes—such, *e.g.*, as the vitriol chamber process—the speaker was not at all sure that considerable annual losses were not suffered through inattention in the night and small hours of the morning. Now in a country like Germany, where every man passes under military discipline, where the duty of the sentinel and the watchman must be learnt at the risk of the well-known alternative—the ounce of cold lead, it may be readily conceived that the efficiency of the “night-shifts” will be much superior to those in this country, and so for the most part nocturnal losses *there* will not occur to nearly so great an extent as *here*. He was disposed to think that military discipline was an important factor in the efficient organisation of German works, factories, etc. With regard to Mr. Levinstein's remarks on the importance of the professors of science in our seats of learning keeping in touch with the manufacturers, the speaker pointed to numerous examples showing how this had been, and is generally the case, in Germany; and referring to older times, pointed to the fact that the well-known black-ash vat was the outcome of the consultation of the German alkali maker, Gmelin, then fresh to the difficulties of lixiviating Leblanc black ash, with the great physicist, Buff or Giessen. He surmised that there was benefit derived in the outcome of that consultation on both sides, for Gmelin got an efficient piece of apparatus, and Buff learnt something of the nature of the crude soda and the difficulties of handling it on the large scale. Great things had also sprung from similar consultations in this country, and the taking counsel together of James Young with Dr. Lyon Playfair and Professor Graham, led to the evolution of the important paraffin industry.

Mr. GRIMSHAW, referring to the competition between English and German chemists, said that it was not altogether a fair stand-up fight between them, but was complicated by the question of Free Trade and Protection. No doubt German protection had fostered the coal-tar industry there to such a point that it was on the verge of over-production. If, heretofore, in England they had failed to compete with foreign countries in their own markets, it might fairly be ascribed to a system of hostile tariffs, and not to technological skill. Now was the time for them to make sure at least of the English trade, in which, if they were beaten, they had but themselves to blame. If they strained every nerve now, the tide might turn in their favour, for foreign nations could not go on for ever selling caustic, alkali, sugar, and such like to the English consumer at or below cost price without disaster to their own country, though individuals might profit through a protected home trade. The English chemical manufacturer ought to be able to defy foreign competition at home, while pressing it hard in its own markets wherever the duties were not absolutely prohibitive. This seemed to be the case with the aniline industry, and it remained, therefore, for the Society of Chemical Industry and the colleges of science to point out the proper method of procedure.

Dr. CONEX thought that the author had hit the right nail on the head when he urged the importance of teaching chemical engineering as well as laboratory work; but he also thought that it was cheap education, both elementary and advanced, by reason of schools, universities and polytechnic institutions receiving state aid, which contributed still more largely to the success of German chemical industries.

The author specially ascribed this success to the cultivation of chemical engineering in Germany, but for himself he would divide the honour between the chemical engineer and the scientific chemist. Pure chemistry had become so extended a science that it was necessary nowadays to devote one's whole time to master it thoroughly; hence in this, as in technical chemistry, specialists were required. It was only when these worked side by side that real progress was achieved. Witness the number of important chemical products discovered by men who never were in chemical works at all. He thoroughly agreed with Professor Meldola's views, expressed in a recent paper, in which he urged the importance of the cultivation of pure science. By cheapening education, inducement would be offered to students to remain longer in laboratories, to pass from learners simply to become experimentalists.

Mr. THOMSON said that among the reasons why English manufacturers so often failed to compete in the open market with Germans was that important question of education. In Germany, science formed part of a man's ordinary education, while in England more importance was attached to the study of dead languages than of the laws which governed the world of to-day. This state of things was most unsatisfactory; but, sad to relate, certain so-called learned Englishmen were as proud of their scientific ignorance as they were of their classical knowledge. It was maintained by many that a classical education enabled a man to understand his own tongue better, besides affording a species of gymnastic training to the mind; but surely a study of modern languages would give an equally good mental training, besides being of distinct use to him in the work of the world. But above all, who would be bold enough to deny that a training in mathematics and physical science afforded a better training to the mind than all the classics put together, and such a training as would enable Englishmen to cope with the world in arts and manufactures, and hence in the acquirement of wealth? There was no want of intellect and enterprise in the nation, but it was fashionable to direct this intellect into useless channels, and this was why the Germans excelled us. Masters were selected for boys too often solely for their classical attainments, with the grievous result that their pupils grew up crammed with words, and totally ignorant of the subtle and beautiful laws of nature. Such as the boys were, so would be the men, and thus we had few men in this country capable of turning the forces of nature to account, and utilising them for the benefit of themselves and their country. Would that there were more men like Mr. Levinstein, who would boldly define the causes which were tending to deprive England of her supremacy as a manufacturing and wealthy nation, and point out the remedies essential to the cure of the evil.

Dr. BAILEY said that there was an undoubted feeling that English universities and colleges were not doing all that they might do in this matter, and there were many who looked upon the elevation of the Owens College to university rank with a feeling akin to distrust. This was a mistake, for admitting even that the adoption of a university regime brought conservative tendencies in train, yet it must not be forgotten that Owens College still remained, and was doing for the technical student more than she had ever done in the past. This Society, also, with its powerful organisation, was quite the creation of recent years, and was fully competent to indicate in what direction further extension of teaching was desirable. More science and better teaching were undoubtedly required for middle-class schools, and, moreover, science must be taken up much earlier in the school

career, and until this lack of early instruction in science was remedied no considerable improvement could be expected in our colleges.

Mr. LEVINSTEIN (in reply) thoroughly agreed with Mr. Watson Smith that the three years' compulsory service in the German army, with all its disadvantages, had its salutary effect on the character of the men, as it taught them general discipline, subordination, punctuality, etc., and in no other industry were these qualities more needed by the working men than in the chemical industries. Mr. Grimshaw's remarks in reference to the fiscal policy of England and Germany, did not apply, in his (Mr. Levinstein's) opinion, to the observations in his paper, as the duty on soda did not in any way explain the fact that this article was sold at a lower value in Germany than in this country. As regarded the coal-tar colours, Mr. Grimshaw was labouring under a delusion, as there were no duties on these colours. He would recommend Dr. Cohen to carefully peruse his paper when it appeared in the Journal, and he would find there no such singular statement as that the success of Germany in the coal-tar industry or any other chemical industry was due to chemical engineering. He was fully alive to the fact that for striking out new lines chemical specialists of talent were required, and for the carrying out of known chemical processes, chemists of sound scientific training and chemical engineers were wanted. As pointed out in his paper, our present scarcity of chemical engineers was only the natural consequence of our neglect of the coal-tar industry, and with its development all other requirements would spring up *pari passu*. He quite agreed with Dr. Cohen as to the general excellence of Professor Meldola's last paper on the development of the coal-tar industry, of which he had read a few passages, but he could not endorse the Professor's opinions "that it is now a question of chemical and not of economical science that is pressing for consideration," nor that "the English manufacturers should look after the science and leave the technique to take care of itself."

After his reply, Mr. Levinstein referred to his last paper on Saccharine (*Journal of the Society of Chemical Industry*, 1886, 75-76), in which he pointed out the likelihood of this substance entering the market as a commercial product, and, as he had received a large number of letters on this subject, he thought that it might be of interest to many to hear that a company has now been formed in Germany for the purpose of erecting works for its manufacture. Suitable land has already been chosen near Magdeburg, and it is expected that saccharine will be offered to the trade in the beginning of next year.

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J. J. Coleman, 45, West Nile Street, Glasgow.

Local Secretary:

G. G. Henderson, Chemical Laboratory,
University of Glasgow.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

The Seventh Meeting of the Session was held in the Rooms, 207, Bath Street, on Tuesday, 4th May 1886.

MR. J. NEILSON CUTHBERTSON IN THE CHAIR.

NOTES ON VISCOSITY AND OTHER TESTS FOR OILS.

BY J. J. COLEMAN, F.I.C., F.C.S.

THE author regretted that he was not able to be present at the last meeting, and to join in the discussion upon the paper of Professor Mills and that of Mr. Ellis, but as he had perused them in print, and also the excellent paper read by Mr. Boverton Redwood at the London Section, perhaps the remarks he had to make now would be more carefully considered than otherwise they would have been. The author used a pipette about seventeen years ago for determining the viscosity of oils whilst making some experiments with spindle oil at the celebrated carpet works of John Crossley & Sons, Limited, Halifax.

At that date none of our great oil merchants or dealers appeared to use any instrument for the determination of viscosities. The author, however, introduced regular viscosity determinations at the works of Young's Oil Company about fifteen years ago, and the instrument used for many years is described in a paper read to the Institute of Engineers and Shipbuilders of Scotland, 24th November, 1872.

At the same meeting a discussion arose upon oil-testing machines, and remarks which coincide very much with those of Mr. Redwood were then made, and which was to the effect that makers of mechanical oil-testing machines generally assume too much. Such machines give an idea of the viscosity of the oil (McNaught's, for instance), but it is a total error to assume that the oil which gives the least friction with a small testing machine will also work with little friction on a piece of heavy machinery, or *vice versa*. As Mr. Redwood concisely puts it, "the lubricant must have such viscosity as to keep the moving surfaces apart at the maximum pressure," to which I will add, any increase of viscosity will augment the friction, and any decrease will also augment friction, the former resulting from friction amongst the particles of the lubricant, the latter from the metallic surfaces approximating too closely. Hence it follows that the suitability of an oil for a particular class of machinery, can only be determined by trying it upon journals or bearings of the same size and subject to the same pressures as that of the machine itself.

Once determine this point by experiment, and it will be found that a particular viscosity is suitable for the work, and such instruments as the pipette, those of Mr. Redwood, or even the old but excellent apparatus of McNaught, can be used to adjust fresh supplies exactly to the viscosity of the sample known to succeed on the machinery.

It occurs to the author that a very simple means of taking viscosities would be the inversion of the pipette method. Instead of making the oil to run out of the pipette, why not allow the oil to run into it, noting the time required for the oil to ascend from a mark on the lower stem to a mark upon the upper one? This method would involve closing the top of the pipette with a temporary stopper (say the finger), and thrusting the empty pipette down to a certain point below the surface of the oil. Moreover, it is a

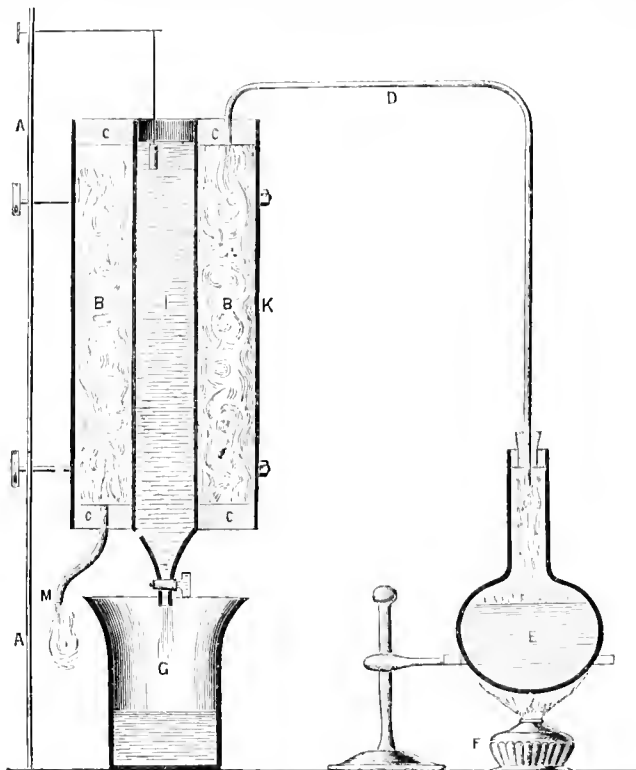
method that would simplify adjustments of temperature, a troublesome operation in all forms of apparatus.

The oil might be put into a glass tube like a very large test tube, *a-b*, say nine inches by one and a half inches, fitted with a cork through which the stem of a thermometer dipping into the oil is made to project. By dipping this tube into cold water on a warm day, or warming it slightly with a spirit lamp on a cold day, and moving it alternately from a vertical to a horizontal position so as to avoid air bubbles, the contained oil could quickly be brought

to the point *d*. A special form of pipette, with the bottom stem of uniform bore, should be adopted. As the temperature of the oil box of a locomotive engine is generally not less than 120°, and as most lubricants should be compared with melted tallow, this temperature is not too high for general use.

Instruments constructed on the pipette principle, such as those of Mr. Redwood or Mr. Allen, might be called "Oil Transpirometers"—the flow of liquid through tubes being described by Graham as "liquid transpiration." This would distinguish them from such instruments as those designed by our townsman,

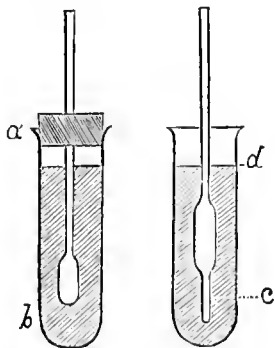
SKETCH TO ILLUSTRATE TERM VISCOSITY AS USED BY MR. COLEMAN.



I, is the cylinder containing the oil. B, the chamber filled with steam, and surrounded by the outer cylinder K (both of glass); the steam chamber is closed, top and bottom, by india-rubber plugs, C, C, C, C. The steam being generated in the flask E, passes by the pipe into the chamber B, until the oil reaches 120°; the stopcock is then opened, and the time taken for the oil to run out registered. The apparatus is made of such size as to allow rape-oil to run through in 8 minutes exactly.

to the desired temperature. The cork and the thermometer being then removed, and the pipette substi-

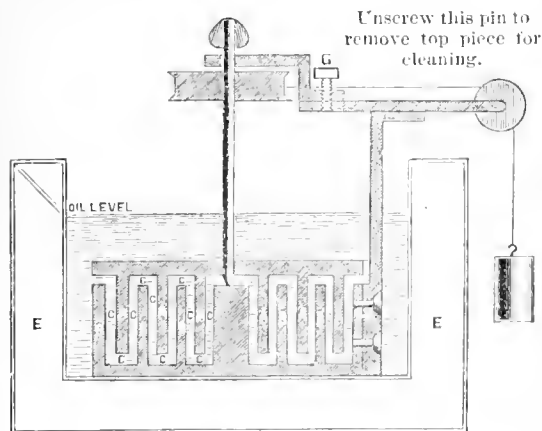
Mr. James Napier. Mr. Napier has been kind enough to send one partly finished from the workshops of White, the optician. It reminds one very much of the contrivances of Dr. Joule for measuring the mechanical equivalent of heat—viz., a horizontal paddle, the vertical shaft of which is connected by a string passing over a pulley to a falling weight—the speed of the fall of the weight measuring the resistance of the medium in which the paddle works. It is obvious that if the specific gravity of the oils being compared be identical, then the true viscosity will be indicated by the falling weight. If, on the other hand, the specific gravity of the oils vary, then the resistance will be partly owing to viscosity and partly to the weights of oil being displaced by the paddles being proportional to the specific gravity. It will be seen, however, from the annexed sketch, that Mr. Napier's improved arrangement is not a paddle which sets up motions in the oil to any very serious extent, so that it becomes a fair measure of viscosity; further, the author can see no force in the objection of Mr. Redwood that the friction of bearings will be a source of error—as if sufficiently accurate for Dr. Joule's



tuted, the viscosity of the oil could be ascertained by the length of time required to ascend from the point

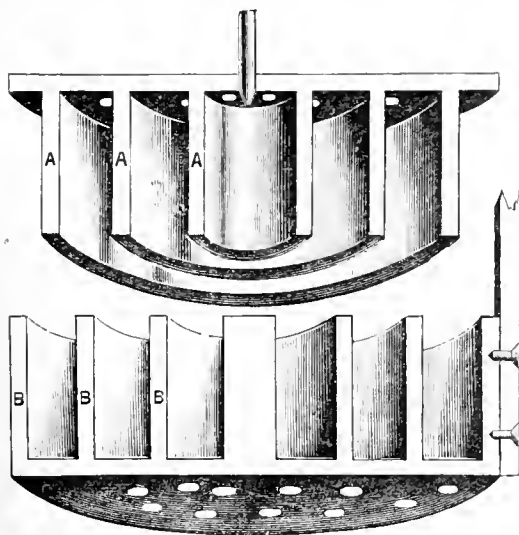
experiments, it is surely so for a commercial oil test.*

In regard to the oil which has to be used as a standard, probably the oil known to apothecaries as oil of sweet almonds, which is almost pure oleme, is of all oils the most constant in quality. Rape oil, however, is certainly the most extensively used and important of vegetable oils, and will perhaps maintain a preference as a standard. It has not, how-



SECTION.

A.A.A. concentric rings $\frac{1}{4}$ in. thick, $\frac{1}{2}$ in. deep, on circular plate with driving gear. B.B.B. ditto. With stand attached. D.D. C.C.C., etc., spaces of $\frac{1}{4}$ in. between the fixed and moving rings, to be filled with the oil, etc. E.E. jacketed vessel to regulate temperature of oil, etc.



PERSPECTIVE SECTION.

MR. NAPIER'S VISCOMETER.

ever, such a constant specific gravity and viscosity as some people imagine. The author has not had any recent experience in the matter, but between the years 1870 and 1880 sampled a large number of fifteen parcels, amounting in all to over 1000 tons. About a third of it came from Stettin, in Germany, one-third from France and Belgium, and one-third

was English crushed. The specific gravity of the German oil was invariably 915 $\frac{1}{2}$, that of the French and Belgian 912, and that of the British 915 to 916 $\frac{1}{2}$, corrected for temperature at 60° F. Possibly the French and Belgian oils would be called colza by some people, but the brokers always quoted it as rape oil, and the price coincided with Stettin rape oil of same date. Mustard and other seeds seem to find their way into the rape seed used by English crushers, which no doubt affects the specific gravity of the oil. Possibly the equal admixture of German, French, and British oils would give a fair standard—otherwise a rape oil standard may vary as seven to eight, or more.

The author is glad to see that Mr. Ellis calls attention to Mauméné's test for oils. In his paper read to the Philosophical Society of Glasgow, 1874, this test was pointed out as one of the few really useful tests suggested by chemists. (See *Chemical News*, vol. xxix. Nos. 748–751.)

NOTE ON MAUMENÉ'S TEST FOR OILS.

BY CHARLES J. ELLIS, F.C.S.

SINCE reading my paper on "Mauméné's Test for Oils" before this Section on 2nd March, I have received the following letter from M. Mauméné:—

M. ELLIS, F.C.S.

MONSIEUR ET CHER CONFRÈRE,—J'ai lu avec un grand plaisir l'article du *Journal of the Society of Chemical Industry* (29 Mars 1886), dans lequel vous exposez les recherches si précises que vous avez faites pour donner à ma méthode d'essai quantitatif et qualitatif des huiles une extension favorable.

Votre bienveillance m'inspire seulement un regret. Vous avez connaissance de mon travail par les *Comptes Rendus* et le *Journal de Pharmacie*. Ces journaux ont donné des extraits peu étendus.

Permettez moi de vous adresser un des exemplaires qui me restent où vous trouverez beaucoup plus de détails et où vous verrez, j'espère, la preuve de mon application à résoudre la question de la manière la plus générale.

- (1) En diluant les huiles siccatives avec l'olive ou une autre huile pour éviter de trop forte dégagement.
- (2) En faisant plusieurs preuves avec des quantités différentes d'huile (ou du mélange huileux) et d'acide.

50grms. de mélange et 1Sec. d'acide.

50	"	"	36	"	
100	"	"	18	"	etc., etc.

Le qui permet de calculer avec une grande approximation la *qualité* et la *quantité* des huiles inconnues existant dans le mélange.

Vous serez mon juge et si vous trouvez bon de porter à la connaissance des chimistes anglais le jugement que vous prononcerez après la lecture de mon mémoire, je vous en serai reconnaissant.

Veuillez agréer, Monsieur et cher confrère, l'assurance de mes sentiments les plus distingués,

E. MAUMENÉ.

Paris, 11 Avril 1886.

As M. Mauméné remarks in his letter, the references which I gave were only short abstracts of his original paper, but as they were the only ones given in the Royal Society's catalogue of scientific papers, and as the original paper (published by the Imperial Academy, Rheims, 1852) is one, a copy of which appears difficult to obtain, I trust I may be excused for not having perused it before reading my paper. I have now, however, read it through carefully, and find in it a very extensive and minute description of details. M. Mauméné draws attention to the necessity for admixture of another oil when testing the drying oils, in order to avoid too violent an action

* Mr. Napier's latest instrument is now being made at White's, in the form of a hollow drum revolving vertically in a brass cylinder, the diameter of which slightly exceeds that of the drum.—June 23.

between the oil and the acid; however, he only records one or two experiments on this subject, and in those he has used olive oil as retarding agent, for which the rise alone is about 40°C ., and gives no hint as to the using of mineral oil. I am still strongly of opinion that the use of mineral oil, on which sulphuric acid has a comparatively slight action, is much to be preferred as a retarding agent to olive or a similar oil, for the following reasons. My experiments led me to the conclusion that in order to obtain the most concordant and reliable results, the maximum temperature attained should not exceed 60°C ., which temperature appears to be a critical one in many chemical reactions. In order to be able to fulfil this condition with the least possible admixture of retarding oil, it is necessary to choose a retarding oil on which sulphuric acid has the least action practicable. By using such an oil as olive, a comparatively small range of temperature is at one's disposal, and therefore only a small proportion of the mixture could consist of the drying or fish oil to be tested if the above condition were to be fulfilled. I may make my meaning more clear by an example. Let the initial temperature in all the experiments be 10°C ., and the rise in temperature due to the mineral oil in a mixture containing two-thirds of it, 10° ; the rise for such an oil as olive, 40° ; for an oil A, 120° ; and for an oil B, 75° .

First, using olive or similar oil as retarding agent—

Mixture.	Maximum Temperature.	Range.
$\frac{1}{3}$ A, $\frac{2}{3}$ Olive	$(10^{\circ} + 35^{\circ} + 15^{\circ}) = 60^{\circ}$	) $5^{\circ} 3'$
$\frac{1}{3}$ B, $\frac{2}{3}$ Olive	$(10^{\circ} + 35^{\circ} + 9 \cdot 37^{\circ}) = 54 \cdot 37^{\circ}$	

Second, using mineral oil as retarding agent—

Mixture.	Maximum Temperature.	Range.
$\frac{1}{3}$ A, $\frac{2}{3}$ Mineral.	$(10^{\circ} + 10^{\circ} + 40^{\circ}) = 60^{\circ}$	) 15°
$\frac{1}{3}$ B, $\frac{2}{3}$ Mineral.	$(10^{\circ} + 10^{\circ} + 25^{\circ}) = 45^{\circ}$	

Thus supposing a mixture of oils A and B in unknown proportions had to be tested, an error of $\frac{1}{3}$ in the experiment, if olive oil were used, would mean an error of about 9% on the quantities of A and B in the mixture, while by using mineral oil the same error in experiment corresponds to only 3.3%.

On the other hand, it may be objected that it is more troublesome to determine the standard rise for the mineral oil than for olive; but I should think this a very slight objection, especially in laboratories where oils are being frequently tested; for a stock of a special mineral oil can be kept at hand for which the standard value has once and for all been determined, which is easily done for various proportions by means of the formula given in my paper; and I should think the advantage, which appears to be gained by its use, should more than counterbalance any slight extra trouble.

DISCUSSION.

Professor MILLS said that it had been alleged that some connection existed between specific gravity and viscosity. On this point there ought to be no doubt or uncertainty. True they might find a very heavy oil more viscous than a light oil, but that was no evidence of a relationship between the two. Mr. Coleman had suggested almond oil as a standard of viscosity, but did not specify what class of almond oil he would prefer—whether that from sweet or

bitter almonds. All those who used Maumené's test must agree with Mr. Ellis in using mineral oil instead of olive oil, which latter, however, often gave good results. Maumené himself would be the first to admit the use of mineral oil when he read Mr. Ellis's remarks.

Mr. PATTISON said that the great attention which this subject had of late received, was perhaps an evidence of the existing depression in trade and the resulting desire to economise. No doubt in prosperous times great loss arose from the use of unsuitable oils, and any process which would aid in the selection of suitable lubricants was worthy of close attention. From the discussions on papers read in Glasgow and elsewhere they had learnt that neither specific gravity nor viscosity were, either alone or in combination, absolute measures of value. For example, sperm oil—an oil of low gravity and viscosity—was an excellent lubricant. Could they ascertain what became of the oil which was put upon machinery, it might afford some evidence of the changes it underwent. As it was impossible that at the temperature of friction it was volatilised, might it not be decomposed in some way? Hence should they not direct their investigations towards those oils which were most unalterable, and lasted longest in use?

Mr. COLEMAN, in reply, said that there was no reason to suppose that lubricating oils dissipated themselves in vapour or gas, or that, except in the case of vegetable oils, oxidation occurred. There were other qualities besides viscosity desirable, but unquestionably the using of an oil of proper viscosity was the most important, or the consequences might be serious in large cotton and other spinning mills. Sperm oil, which had about half the viscosity of rape or lard oil, was best adapted for spinning machinery; but of late years, owing to the scarcity of sperm oil, almost all spinning machinery was run by rape or lard oil diluted to the viscosity of sperm oil by admixture of mineral oil, hence the importance of measuring the viscosity of mixed oils.

ACTION OF OILS ON METALS.

BY I. J. REDWOOD.

VERY little has yet been published in regard to the action of oils in common use on metals with which they are brought in contact when stored, transported, or employed for the lubrication of machinery; and as the subject is of importance, especially to manufacturers of compound lubricating oils, and to those who use such oils, the following record of the results of experiments extending over twelve months will, it is confidently hoped, be found of practical value.

Mr. C. W. Volney has made a few experiments on the action of oils on brass,* and finds that of olive, cotton-seed, and lard oils, the first has the most action and lard oil the least. Mr. W. H. Watson, in a paper on "The Action of various Fatty Oils upon Copper,"† points out that seal oil has more action than sperm oil.

Dr. Stevenson Macadam has investigated the action of paraffin burning oils on metals,‡ and states that the action varied with different samples of such oils, and that the variation was not traceable to the presence of impurities. Engler, however, contends§ that mineral oils have no action on metals if free from oxygen and air. In this connection it may be

* Analyst, vol. viii. p. 68.

† Chemical News, vol. xxvi. p. 200.

‡ Journal of the Chemical Society, vol. iii. p. 255.

§ Chemical News, vol. xli. p. 281.

TABLE I.

SHOWING THE ACTION OF DIFFERENT OILS ON A PARTICULAR METAL.

Name of Metal.	Weight in Grammes.		Percentage Loss.	Name of Oil.	Remarks on Oils.	Remarks on Metals.
	At Start.	At Finish.				
IRON	3.713	3.712	0.0263	Mineral Lub.	Slightly darkened in colour	
	3.200	3.1915	0.17187	Olive		
	3.395	3.3835	0.01118	Rape		
	3.3975	3.3905	0.20603	Tallow	Contained reddish precipitate	Partly rusted
	3.118	3.1145	0.11111	Lard		Bottom half covered with rust
	2.928	2.929	— ? —	Cotton seed	Much thickened and contained reddish-brown deposit	Showed traces of rust
	3.256	3.253	0.09210	Sperm		
	3.2575	3.2535	0.12279	Whale		
BRASS.....	3.218	3.2175	0.01539	Seal		Showed signs of rust
	10.182	10.1795	0.02155	Mineral Lub.	Distinctly darkened in colour	
	11.230	Lost — ? —		Olive	Coloured bright emerald green	
	10.111	10.111	— —	Rape		
	8.111	8.110	0.01929	Tallow	Contained reddish-black precipitate	
	9.029	9.021	0.08800	Lard	Contained slight greenish-black sediment	
	8.9515	Tube broken		Cotton-seed		
	7.2905	7.2885	0.02743	Sperm		
	9.811	9.8115	0.02517	Whale		
	10.511	10.513	0.00951	Seal	Surface gelatinised for $\frac{1}{2}$ -inch	Surface covered with dark film
TIN	3.861	3.863	0.02587	Mineral Lub.	Reddish in colour	
	3.0535	3.0530	0.01637	Olive		
	2.831	2.831	— —	Rape		
	2.911	2.910	0.03100	Tallow		
	2.550	2.555	0.03976	Lard		
	3.0385	3.0215	0.16075	Cotton-seed		
	3.512	3.511	0.02817	Sperm		
	3.1525	3.1525	— —	Whale		
	2.552	2.550	0.08503	Seal		
LEAD	12.183	12.176	0.05007	Mineral Lub.	Distinctly darkened in colour	
	8.248	8.2415	0.01213	Olive	Had a greenish tinge	Thick slimy deposit on surface
	6.847	6.8335	0.19716	Rape		Thick slimy deposit on surface
	9.531	9.518	0.16782	Tallow		Slight slimy deposit on surface
	8.211	8.191	0.28000	Lard		Thick slimy deposit on surface
	7.7315	7.7260	0.07113	Cotton-seed		
	6.1965	6.1790	0.28211	Sperm		Thin yellowish-brown deposit on surface
	6.835	6.808	0.29502	Whale	Contained a flaky gelatinous deposit	Covered with a white deposit
ZINC	7.013	7.033	0.14198	Seal		
	0.499	0.499	— —	Mineral Lub.		
	8.477	8.487	— ? —	Olive	Contained a flaky gelatinous deposit	Covered with a white deposit
	6.855	6.872	— ? —	Rape	Contained a flaky gelatinous deposit	Covered with a white deposit
	7.812	7.8215	— ? —	Tallow	Reddish-brown in colour	Large deposit on surface
	7.251	7.2175	0.04826	Lard		
	7.952	7.939	0.16348	Cotton-seed		
	8.1575	8.0885	0.84585	Sperm		
	6.993	7.0215	— ? —	Whale		
	1.500	1.516	— ? —	Seal	Rather brown in colour	Surface covered with slime
COPPER	3.202	3.202	— —	Mineral Lub.	Very much darkened in colour	
	1.251	1.2185	0.19981	Olive	Had a greenish colour, and very much thickened at surface	Covered with a thick blue deposit
	1.183	1.180	0.25380	Rape		
	1.207	1.202	0.11425	Tallow		
	1.052	1.0185	0.33269	Lard		Thick deposit on surface
	1.217	1.215	0.16433	Cotton-seed	Contained a yellowish deposit	Thick deposit on surface
	1.193	1.192	0.08382	Sperm		
	1.190	1.1885	0.12605	Whale		
	1.201	1.200	0.33222	Seal		

remarked that the action of hydrocarbons on metals has been generally considered to be due to impurities, such as water and slight traces of phenols and bases, which most commercial paraffin oils contain, on account of the difficulty of entirely removing them.

The experiments were made principally with a view to determine what fixed oils are best adapted for mixing with mineral oils for lubricating purposes.

Metals in ordinary use were employed, and after being thoroughly cleaned, washed with ether and dried, were weighed and placed in cork tubes together with 15cc. of the oil. These tubes were kept for 12 months at an average temperature of about 80° F. in the summer, and at 50° to 55° F. in the winter. It should be mentioned that the tallow oil was solid for four months during the winter of 1884, and one month at the commencement of the winter of 1885.

After the lapse of the twelve months, the oils were all poured off from the metals and set aside for examination, and the metals, after being carefully washed with ether and cotton wool, were dried and weighed. On referring to the tabular statements of the results, it will be seen that in the case of one iron and five zincs the metals gained in weight during the exposure to the action of the oils. This increase in weight is accounted for by the fact that, in the case of iron, the metal contained a flaw which had not been noticed and which became filled with oxide, and therefore could not be thoroughly cleaned; in the case of the zinc, block metal had been inadvertently used; and in all five cases, the rough surface had become covered with a deposit which could not be removed.

Table I. shows the weights of the different metals before and after exposure to the action of the oils, and the percentage loss sustained.

In order to facilitate comparison of the results, a diagram has been prepared. It shows the percentage losses as given in Table I. The results obtained with those metals which gained in weight in the manner described, and those which lost nothing, have been omitted.

On referring to the table and diagram it will be seen that—

Iron is least affected by seal oil, and most by tallow oil.

Brass is not affected by rape oil, least by seal oil, and most by olive oil.

Tin is not affected by rape oil, least by olive oil, and most by cotton-seed oil.

Lead is least affected by olive oil, and most by whale oil; but whale, lard, and sperm oils all act to very nearly the same extent on lead.

Zinc seems, by the four actual weighings that were of any value, to be not acted on by mineral lubricating oil, least by lard oil, and most by sperm oil.

Copper is not affected by mineral lubricating oil, least by sperm oil, and most by tallow oil.

The table and diagram also show that—

Mineral Lubricating Oil has no action on zinc and copper, acts least on brass, and most on lead.

Olive Oil acts least on tin and most on copper.

Rape Oil has no action on brass and tin, acts least on iron, and most on copper.

Tallow Oil acts least on tin and most on copper.

Lard Oil acts least on zinc and most on copper.

Cotton-seed Oil acts least on lead and most on tin.

Sperm Oil acts least on brass and most on zinc.

Whale Oil has no action on tin, acts least on brass, and most on lead.

Seal Oil acts least on brass and most on copper.

From the foregoing results it will be seen that mineral lubricating oil has, on the whole, the least

action on the metals experimented with, and sperm oil the most.

For lubricating the journals of heavy machinery, either rape or sperm oil is the best oil to use in admixture with mineral oil, as they have the least effect on brass and iron, which two metals generally constitute the bearing surfaces of an engine. Tallow oil should be used as little as possible, as it has considerable action on iron.

All the oils were examined for the respective metals with which they had been in contact, by the following methods:—

Iron.—Agitate the oil with a dilute solution of nitric acid, draw off the solution and evaporate to dryness on the water bath in a small porcelain basin. Take up with water, and add ammonia and sulphuretted hydrogen water.

Brass.—See copper.

Tin.—Extract with dilute hydrochloric acid, evaporate solution to dryness, take up with water and a few drops of hydrochloric acid, and to this add a few drops of a mixture of a solution of ferric chloride and ferrieyanide of potassium. If tin be present, a precipitate of "Prussian blue" will be given.

Lead.—Extract with dilute nitric acid and evaporate solution to dryness, dissolve in water and test with sulphuretted hydrogen water.

Zinc.—Extract with dilute hydrochloric acid, evaporate, take up with water and add ammonia and ammonium sulphide.

Copper.—Extract with dilute nitric acid, and evaporate (after the addition of a few drops of pure sulphuric acid) to a small bulk in a porcelain basin in order to remove all nitric acid. Dilute with a little water and place a new clean needle in the solution. The needle will soon become coated with a film of metallic copper if any be present.

The chemical examination of the oils appears to afford the most trustworthy guide in determining what metal is best adapted for the construction of storage tanks for the different oils; as in some cases where the percentage loss of metal arising from the formation of a deposit not taken up by the oil was high, only a trace (and in some cases no trace) of the metal was found in the oil.

Some of the oils have both a dissolving and depositing effect, while others have only one or the other. Slight traces of copper and zinc were found in the mineral lubricating oil, although the weighings showed the metals to have lost nothing; this indicates the importance of examining the oils for the metals.

In conclusion, I beg to thank my employers, Messrs. Young's Company, for allowing me the time and use of the Addiewell laboratory for carrying out these experiments.

Bristol and South Wales Section.

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F. Player.

W. Pringle.
Albert E. Reed.
G. S. Schacht.
W. A. Sherston.
C. M. Thompson.
W. Windus.

Local Secretary and Treasurer:

E. G. Marks, St. Augustine's Chambers, Unity Street, Bristol.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

DIAGRAM 1.

- 1 = Mineral Lubricating Oil.
- 2 = Olive Oil.
- 3 = Rape Oil.
- 4 = Tallow Oil.
- 5 = Lard Oil.
- 6 = Cottonseed Oil.
- 7 = Sperm Oil.
- 8 = Whale Oil.
- 9 = Seal Oil.

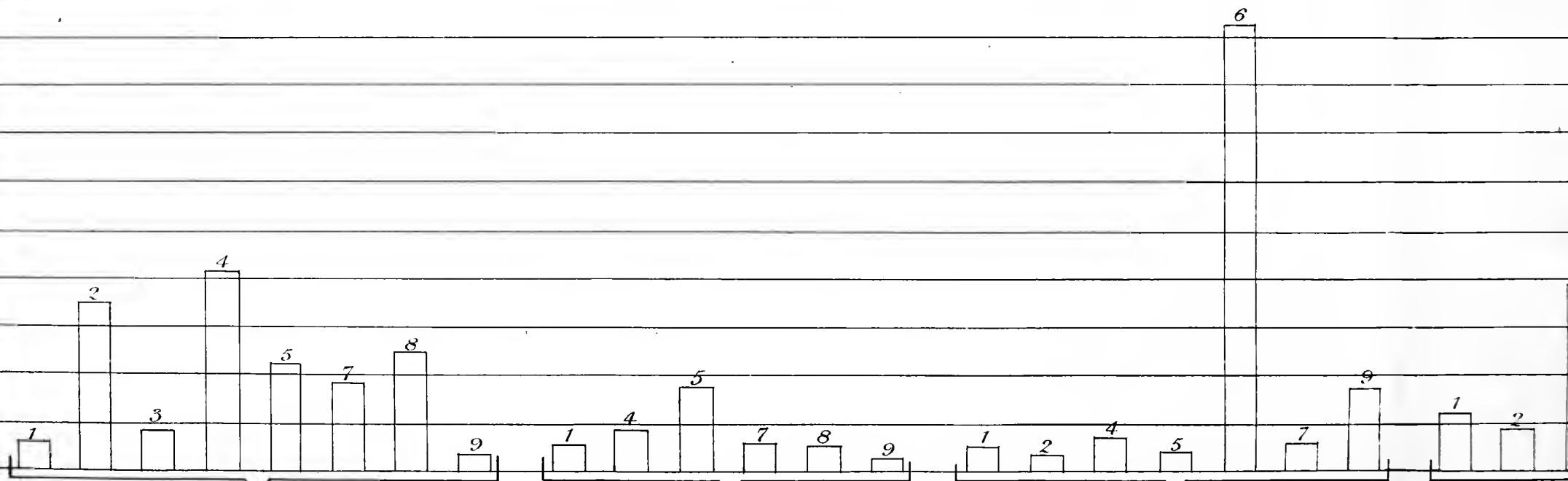
Scale of Percentage Loss.

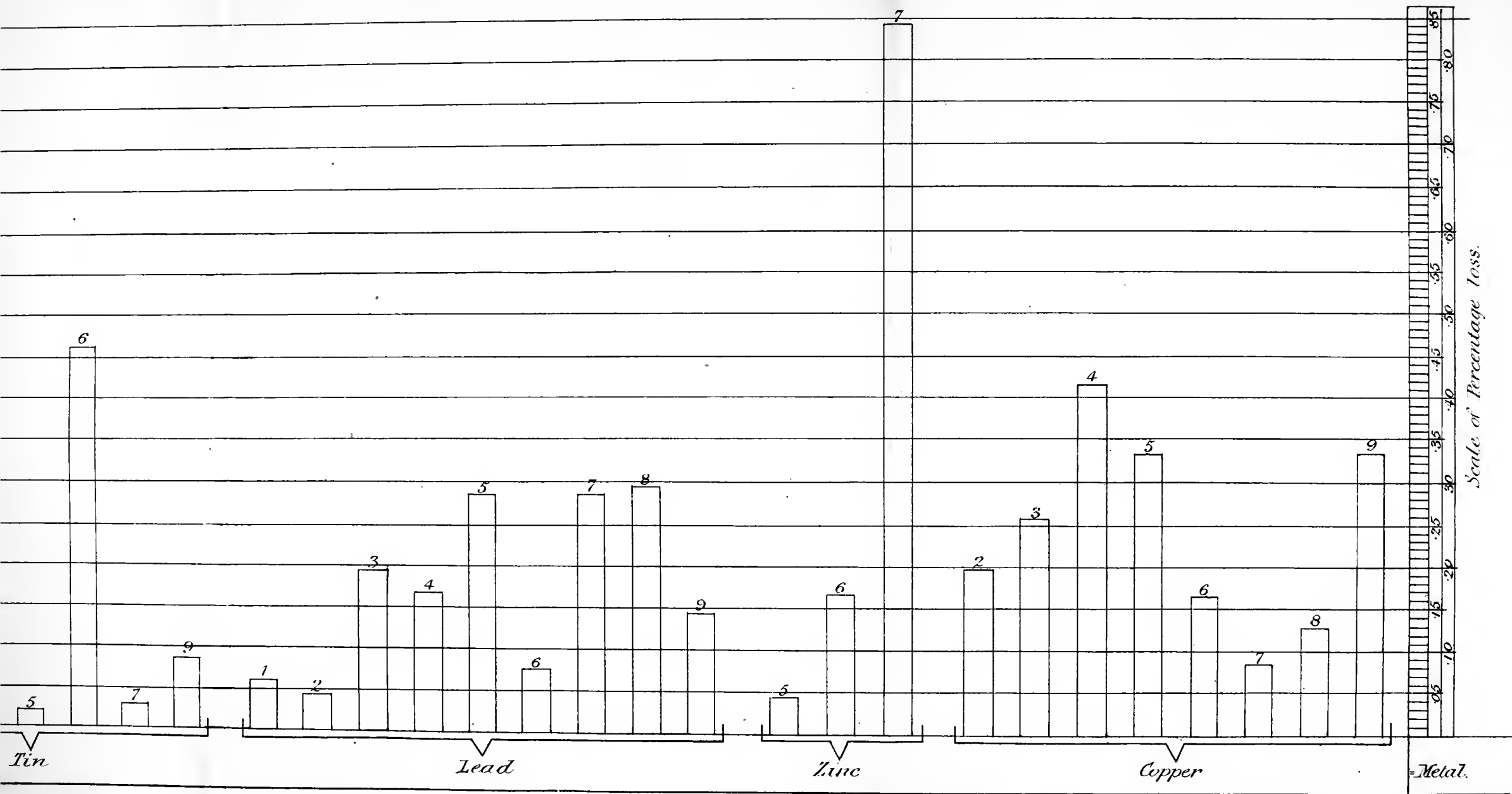
Metal =

Iron

Brass

Tin





Meeting held at Cardiff, 13th April, 1886.

DR. RAMSAY IN THE CHAIR.

ESTIMATION OF MANGANESE.

BY R. W. ATKINSON, B.Sc.

SOME little time ago an agitation sprung up for rendering uniform the analytical methods employed by various chemists in analysing the same products, the very laudable and desirable object being to do away with the discrepancies in the results furnished by different chemists as far as might be. I do not propose to enter into this question further than to suggest that the most practicable way of arriving at uniformity is by each one publishing his experience in the work with which he is most familiar, and by the publication of comparative results of different methods. It is with this view that I venture to communicate to the Society the conclusions I have come to in respect of the methods in general use for the estimation of manganese; not that I am able to announce any new process which is perfection, but to point out how the results obtained by different chemists using different methods vary from one another and to show why the variations occur.

Sellers of manganese ore have, with the progress of analytical methods, found the percentages of manganese in their ores steadily diminish, and they have at the same time found prices falling so that they have been unable to make the latter balance the former. In the earlier days, before it was so generally known as at present that the peroxide of manganese when formed in presence of barium, lime or zinc salts, carries down with it important quantities of these metals, no attempt was made to remove them before the precipitation of the peroxide, and thus the latter body was weighted with variable amounts of these elements. As the barium often amounts to four or five per cent., the lime to even more, and the zinc to two or three per cent. of the ore, there can be no wonder if from this cause alone the results rose one and one and a half per cent. above the truth, and the first step, therefore—the removal of the barium by the addition of dilute sulphuric acid before oxidation of the manganese—was in the direction of reducing the apparent percentage of manganese in the ores. The removal of the zinc and calcium is not such a simple operation, and by the majority of chemists who use the gravimetric method no attempt is, I believe, made to remove them, hence the results obtained in this way have the character of being too high, a circumstance which has led to the introduction of the volumetric method, about which more hereafter.

Another very serious source of error in the older methods of manganese analysis consisted in the use of fixed alkalis in the process. It hardly now needs to be insisted upon amongst chemists that once sodium or potassium salts are introduced into the solution, the energy of combination between the manganese peroxide and the alkalis is so strong that it is practically impossible to separate them. The explanation of this fact is doubtless the same as that of the calcium, barium and zinc being carried down with the manganese peroxide—namely, that the latter acts as an acid and combines with bases in preference to a molecule of the protoxide of manganese. Weldon has taken advantage of this in his process for the recovery of manganese from the chlorine-still liquors, by introducing a certain amount of lime, which, by replacing the manganese oxide, allows a larger proportion to be peroxidised to MnO_2 . In analytical operations the only way to avoid an error of this

kind leading to high results is to avoid the use of potassium or sodium salts in any part of the process, and to replace them by ammonium salts, which, even if they are held by the manganese peroxide during the precipitation, are completely removed by the ignition of the precipitate.

The above are the main sources of error which result in the percentages of manganese coming out too high, and it will not, therefore, be a matter of surprise to learn that the same ores ten or more years ago were reported to contain two and three per cent. more manganese than at present. There is, however, an error acting in the opposite direction in the estimation of manganiferous iron ores, but which sellers' chemists early detected and corrected. This lies in the fact that peroxide of iron, when precipitated in the presence of a manganese salt, invariably holds more or less of the latter, and thus leads to a deficiency of manganese. Sellers' chemists were careful to avoid this loss, even at the expense of increased trouble to themselves, by redissolving the first precipitate of ferric oxide and precipitating a second time, whereby only traces of manganese are retained, the remainder going into the filtrate which is added to that first obtained, and practically the whole of the manganese is in this way separated from the iron.

In considering how the various sources of error above mentioned could be eliminated, we have been led to adopt the following procedure, which, in principle, is the old gravimetric method, and depends for its accuracy only on attention to details, combined with a recognition of the fact that the first precipitated peroxide of manganese is impure, retaining both lime and zinc oxide when these are present in the original ore, as they usually are. Starting with the ore finely ground and well dried, we weigh out one to two grams according to its richness in manganese, and having dissolved it in from ten to twenty cc. of pure hydrochloric acid in a small beaker provided with a glass cover, we heat with the cover on until the chlorine liberated is completely expelled. From five to ten cc. of dilute sulphuric acid (strength one to six) are added, and the mixture carefully evaporated to dryness in the beaker upon a warm part of the hot plate, the evaporation being conducted slowly to avoid risk of spitting. When dry the beaker is gradually advanced to the hottest part of the plate, where it is allowed to remain until there is no longer any acid smell to be detected, after which the beaker is cooled and ten to fifteen cc. hydrochloric acid added to the residue. This is then warmed until solution is completely effected, after which the liquid is diluted and filtered through Swedish paper. The filtrate contained in a large narrow-sided beaker is nearly neutralised with ammonia, and finally neutralised entirely with ammonium carbonate solution, until the solution attains a dark reddish-brown colour, upon which twenty-five to thirty cc. of a strong oily solution of ammonium acetate are added, and about 500 cc. of water. The cover being replaced, the beaker is placed upon the hottest part of the plate, and allowed to remain there until the liquid just begins to froth. If allowed to remain longer, the basic ferric acetate, which has in the meantime separated, becomes slimy and will refuse to filter, but if the beaker is removed when boiling first sets in distinctly no difficulty whatever is experienced, filtration goes on rapidly, and the precipitate is easily washed with hot water containing one per cent. of ammonium acetate. The filtrate is collected in a wide, lipped beaker and set upon the hot plate to evaporate, whilst the washings are collected in a smaller beaker and added afterwards to the main portion of the filtrate.

The precipitate is next transferred by means of a platinum spatula, as far as possible, to the original beaker, and what remains on the filter-paper is washed through by solution in hot hydrochloric acid. The solution of ferric chloride thus obtained is again neutralised and precipitated by ammonium acetate as before; the second filtrate contains the remainder of the manganese, and the collected filtrates are then mixed and evaporated to about 100cc. or 150cc. This liquor is filtered, if necessary, into a flask, cooled, and bromine added in small portions, and until, with continued shaking, it fails to dissolve any further quantity. During this oxidation, as much effervescence takes place owing to the decomposition of the ammonium salts by the bromine, it is necessary to keep the neck of the flask constantly closed by means of a watch glass, and to rinse into the beaker anything which collects upon it. When the oxidation is complete, the brominated liquid is washed from the flask into the beaker in which the liquid was evaporated, diluted with water, and an excess of strong ammonia added *at once*. The hydrated peroxide of manganese is thus precipitated in a form in which it can be readily and quickly washed even on Swedish filter-paper. The beaker containing the precipitate is heated on the plate in a good draught until it just begins to boil, after which it is placed on one side to settle and then filtered. The precipitate must be washed with a mixture of dilute ammonia and hot water, which we do by blowing at the mouth pieces of two wash-bottles at the same time; after a little practice it is not difficult to make the two streams tolerably regular and uniform.

The filtrate contains the greater part of the lime and zinc, but sufficient remains in the precipitate to render a second treatment with bromine and ammonia necessary. The precipitated hydrated peroxide of manganese is, therefore, removed from the funnel by the same means as the basic ferric acetate before described, and dissolved in the same beaker in which it was precipitated. The acid solution is to be carefully neutralised, leaving the solution rather acid than ammoniacal, and it is advisable to add about ten cc. of ammonium acetate solution, which helps to render the oxidation more regular. The treatment with bromine and ammonia is carried out exactly as before, and the manganese precipitate, now freed from all but mere traces of zinc and lime salts, is collected upon a Swedish filter, well washed with dilute ammonia and hot water, dried in the steam-oven, ignited over the blow-pipe and weighed as Mn_2O_4 . If the precipitate were washed with hot water alone, the precipitate would after a while show a tendency to pass through the paper, which is avoided by the use of dilute ammonia in conjunction with the hot water.

It would appear unnecessary to give a word of caution against allowing the strongly ammoniacal solution to remain at the boiling temperature in contact with the glass beaker, were it not that some chemists occasionally allow this mixture to remain all night in a warm place. As hot ammonia very strongly attacks glass, possibly this may explain some discrepancies, amounting to one and two per cent., between sellers' and receivers' results. Carried out as above directed, the process is a long and tedious one, but the results obtained are much more concordant than when only a single precipitation is resorted to, and fall below the latter from four to five-tenths of one per cent.

Owing to the length of time occupied in the gravimetric method of estimating manganese, we naturally sought a more rapid one, and if possible a volumetric process. Experiments showed that for practical

purposes, with ores containing numerous impurities, there was only one process which showed indications of being a workable one. I allude to that proposed and worked by our member, Mr. John Pattinson, of Newcastle-upon-Tyne, and I need not therefore occupy the time of the meeting with any account of the methods founded upon the use of potassium permanganate or other oxidising agents.

The process which goes under Mr. Pattinson's name, and which I shall speak of as the *volumetric process*, *par excellence*, is based upon an observation of that gentleman that a soluble salt of manganese in presence of a certain proportion of a ferric salt, is completely oxidised by bromine water or bleaching powder solution to the state of peroxide of manganese. Most volumetric methods have hitherto failed from the difficulty of converting more than a proportion of the manganese into the state of MnO_2 , but Mr. Pattinson asserts that this takes place when ferric chloride is present, and Dr. Kessler also states that zinc chloride is equally effective. In the older methods, where no base was present, the impossibility of completely oxidising the Mn to MnO_2 was due to the combination of some of the MnO_2 first formed with a portion of the MnO present, thus preventing its oxidation. The presence of ferric or zinc salts, it is presumed, allows of the replacement of the MnO, and thus effects complete oxidation to MnO_2 . We carry out the process nearly as described by Mr. Pattinson, adding only a few details which are not mentioned in his paper. We weigh out 0.5gm. or 0.6gm. of an ore containing about 20 per cent. manganese, dissolve in 7 or 8cc. of strong hydrochloric acid, and, when dissolved, wash the whole, without filtering, into a large narrow-sided beaker. When cold it is neutralised with precipitated carbonate of calcium, until the liquid assumes a reddish hue. 40 or 50cc. of saturated bromine-water are added, and the mixture allowed to stand in the cold for half-an-hour. At the expiration of that time the beaker is nearly filled up with boiling water, and precipitated carbonate of calcium added until there is no further effervescence, and part of the carbonate is evidently unacted upon. A small quantity of spirits of wine is then added, the whole well stirred, and the precipitate allowed to settle. The clear liquid is filtered off and fresh boiling water added to the residue in the beaker, a little spirits of wine being used to reduce any permanganate which is formed. The filtration and washing are repeated until the filtrate when cooled no longer turns blue an iodised starch-paper. During the washing about 1.9 to 2.5grms. of pure granular ferrous-ammonium sulphate are weighed out, washed into the beaker in which the precipitation took place, and about 30 to 50cc. of dilute sulphuric acid added. The filter containing the precipitated manganese peroxide is then placed in the beaker, and the latter is quickly dissolved by the oxidation of a portion of the ferrous salt into ferric sulphate. The remaining ferrous iron is then titrated with potassium bichromate in the usual way. The difference in the number of cubic centimetres of bichromate solution used from the number which the original weight of the ferrous-ammonium sulphate would have required if directly titrated is a measure of the quantity of MnO_2 present, and if we assume that the manganese is present entirely in that form we have an accurate and ready means of estimating the percentage of that element in the ore. For rapidity and simplicity the volumetric process leaves nothing to be desired; duplicate experiments agree within very narrow limits, and if we accept the assumption that the presence of ferric chloride enables the complete oxidation of the manganese to the state of peroxide, no other process can compete with it.

We have made, in the course of our work, a large number of manganese estimations by each of the methods above described, and as in a large proportion of the cases Mr. Pattinson has also analysed the same ores, I can say, with the knowledge of his figures, which of course I am precluded from giving, that when using the same process our results have never varied by more than one-tenth of one per cent. So much can certainly not be said for the results of various chemists who have used the gravimetric process; nevertheless I have been confronted with the fact that in my own hands the results obtained by using the two methods described in this paper have never coincided except when the ores contain very small percentages of manganese—less than five per cent. I was unable to persuade myself that the four or five-tenths of one per cent., which the gravimetric method almost invariably yields more than the volumetric, was due to impurities retained by the hydrated peroxide of manganese after the double precipitation. Some results I give below, which show how much the percentage of manganese by the two methods differs, and the fact that in many cases in which the comparison could be made, my results agree with those of Mr. Pattinson, indicate that the discrepancy lies in one of the two methods, and not in the manner of carrying out the experiment. To put this to the test I made use of a sample of well-crystallised manganous sulphate, which had the following composition:—

Manganese oxide (MnO).....	23.61
Sulphuric oxide (SO ₃)	41.04
Water	35.35
	100.00

The manganese was determined by precipitation by sodic carbonate in a platinum dish, using every possible precaution to obtain the precipitate free from alkali, and the sulphuric acid found agrees almost theoretically with the manganous oxide. The composition of the salt having been ascertained, a known weight was made up to half-a-litre, and the manganese contained was determined gravimetrically by means of the bromine and ammonia process, and by the volumetric process. In the latter case a considerable excess of ferric chloride was added, and the experiment carried out in exactly the same manner as described. Calculated upon the manganous sulphate taken, the following percentages were found:—

By precipitation by sodic carbonate	23.61
“ “ bromine-ammonia	23.52
“ volumetric process.....	23.10

We see from this experiment that whilst the two gravimetric processes agree very closely, the volumetric method gives a result which is about four-tenths per cent. below the others, an amount quite comparable with the difference between the results of the two methods when applied to manganiferous iron ores. I regret that pressure of other work has prevented me carrying out these experiments in more detail; it would have been more satisfactory to me if I could have had figures to present to the meeting which would have explained, without doubt, the cause of the deficiency. To my own mind there seems every reason to attribute the difference to the incomplete oxidation of the manganese. I have already referred to the extreme difficulty of obtaining perfectly oxidised manganese peroxide; those who remember Dr. Alder Wright's paper on the oxides of manganese, will know that after trying almost every conceivable mode of preparing the peroxide, he found that the products invariably showed a deficiency of oxygen. In the light of his results, and of the experiments I have myself made, I have come to the conclusion that whilst the presence of a ferric salt does permit of a higher stage of oxidation being attained than when it is absent, there

still remains a portion in a lower state of oxidation, and that this accounts for the lower results found by the volumetric process. Formation of permanganate in presence of Fe₂Cl₆, and reduction by alcohol, also leads to a deficiency in the amount of oxygen present.

If we take what seems to be a general result, that an ore containing 20.4 per cent. of manganese shows by the volumetric process only 20 per cent., the result is that only 98 per cent. of the metal present is completely oxidised to peroxide of manganese, which alone is estimated by that method.

As the manganiferous iron ores also contain more or less zinc, it was suggested to me that the higher results obtained by the gravimetric method might be due to the retention by the peroxide of manganese of some small amount of zinc oxide. To put this to the test, I made a solution of the manganese sulphate, which I had already used, and determined the percentage of manganese by both methods, after the addition of 2 per cent. of zinc in the form of zinc chloride. Calculated as before upon 100 parts of the salt, I found:—

By the bromine and ammonium method.....	23.61 p.c. Mn.
“ “ volumetric method	23.23 “ “

The volumetric method in this case gave a slightly higher result; it may be that zinc chloride is more effective than ferric chloride in promoting the oxidation, and, had time permitted, I would have tried the effect of the addition of a larger proportion of zinc salt. That might lead to a workable modification of the volumetric process, but it would not invalidate my argument that the results given by the volumetric process, as usually carried out, are below the truth, and that however tedious, the gravimetric method, in which the manganese is twice precipitated by bromine and ammonia, is the only practical process.

COMPARISON OF GRAVIMETRIC WITH THE VOLUMETRIC METHOD. (PER CENT. MANGANESE.)

	By Double Precipitation.	By Volumetric Process.	Diff.
A	1.82	1.85	+0.03
B	11.51	11.11	-0.37
C	15.75	15.35	-0.40
D	16.72	16.40	-0.32
E	18.39	18.00	-0.39
F	23.65	22.79	-0.86
G	36.67	36.20	-0.47
H	43.80	43.01	-0.76

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Improvements in Apparatus and Proceedings for Purifying and Filtering of Waters. L. Schröter, Guben. Eng. Pat. 5472, May 4, 1885. 8d.

This invention deals with the purification and circulation of the water in a steam boiler. Exterior to the

* Any of these specifications may be obtained by post, by remitting the cost price, plus postage, to Mr. H. Rander Lück, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8d.....	1d.
Above 8d., and not exceeding 1s. 6d....	1d.
“ 1s. 6d., “ “ “ 2s. 4d.....	1½d.
“ 2s. 4d., “ “ “ 2s. 4d.....	2d.

boiler, a vessel of any shape is provided, in the interior of which is a perpendicular pipe, reaching nearly to the top, the lower end being in communication with the water space of the boiler. Communication to the steam space is effected by a regulating valve governed by a float. Water from the boiler enters the vessel owing to inequality of pressure, until the float is raised, admitting steam into the upper part, establishing equality of pressure; a portion of the water then flows off through an outlet in the side of the vessel back into the boiler; that remaining deposits its suspended matter. Condensation of the steam again establishes inequality of pressure, and the operation repeats itself. The mud settling out during the intervals of rest is blown off periodically.

—C. C. H.

Improvements in Apparatus for Separating Solid Impurities from Water or other Liquid. A. Howatson, Lavender Hill, Surrey. Eng. Pat. 6351, May 23, 1885. 8d.

THE object of the apparatus described in this specification is to effect the rapid separation of suspended matter in a liquid without resorting to filtration. The interior of a rectangular tank is provided with a number of "vertical plates with corrugated or angled passages." These are placed near to each other, forming a number of narrow cells. The water containing precipitated matter is admitted at the bottom of the tank, and overflows at the top. During its passage through the angled plates, the cells of which are equivalent to a number of shallow tanks, the precipitate settles out and gradually slides down the surfaces of the plates into a mud pocket forming the bottom of the tank.—C. C. H.

Improvements in Apparatus for Separating Liquids from Solid Matters suspended therein. W. Macnab, London. Eng. Pat. 6587, May 30, 1885. 8d.

THIS specification describes improvements in the apparatus patented by J. Hadden (Eng. Pat. 972, 1883), for separating the suspended matter from a water by subsidence. The shelves upon which the precipitate settles do not run from side to side of the vessel, but are alternately secured to the sides and at the centre; the former do not meet in the centre of the vessel, and the latter do not touch the sides; pockets are thereby formed into which the solid matter slides and may be drawn off. The specification also shows a horizontal form of apparatus similarly constructed.—C. C. H.

Improvements in Filter Presses. S. H. Johnson and C. C. Hutchinson, London. Eng. Pat. 7618, June 28, 1885. 8d.

THE patentees find that the destruction of the cloths used in filter presses, operating upon materials undergoing or liable to putrefaction—e.g., sewage sludge—results from a decomposition of the fibres of the cloth. This change, they find, is best prevented by treating the cloths with enech, or terra japonica. The specification shows apparatus for best carrying this into effect. The cloths are placed in a cylinder from which the air is exhausted, thus compelling the tannin to enter the interstices of the fabric. The claim is for the use of filtering cloths or diaphragms previously treated with a liquor containing tannin.—C. C. H.

Improvements in Forcing Fluids and Semi-fluids by means of Compressed Air, and Apparatus therefor. S. H. Johnson and C. C. Hutchinson, Stratford. Eng. Pat. 8141, July 4, 1885. 8d.

THIS invention relates to improvements in pneumatic apparatus for raising liquids of an acid or semi-fluid nature which cannot satisfactorily be raised by direct pumping. They consist principally of arrangements for the continuous use of the original volume of compressed air first introduced into the apparatus. The inventors make use of three upright vessels of equal capacity, all in communication at their upper ends by means of pipes containing compressed air. Their lower ends have inlet

and outlet pipes for the acid to be raised, and are also connected to water pipes coming from a force pump. There are also floats, valves, etc., for the regulation of the various liquids. The method of working is as follows:—

Assuming the letters A, B, and C to designate the three vessels; the vessel A is first filled with compressed air, under sufficient pressure for overcoming the weight of the column of acid when raised to its full elevation; the vessel B is next filled with acid, and a connection made between A and B by means of their air pipes at the top. On water being then pumped into A, it forces the air contained therein into B, thereby displacing the acid, which is raised to its destination. The air connection between A and B is then closed, and that between B and C opened, C having previously been filled with acid. Water is now pumped into B, displacing the air and forcing the contents of C to their destination, leaving C filled with air and B with water. Meantime, the water which was first pumped into A has been drawn off, and A filled with a new supply of acid, either by gravitation or otherwise. On C being now connected with A by means of the air pipes, and water being pumped into the former, the air is driven over into A, displacing and raising the acid from the latter vessel and leaving it ready for the next operation. Thus the process is continuous, and as the compressed air is never allowed to escape, no power is lost from that cause. The specification and drawing should be consulted.—B.

Improvements in Acid Taps and Valves and Seats for Chemical Works. W. Allen, Manchester. Eng. Pat. 8499, July 14, 1885. 6d.

THE improvement relates to a method of lining cocks and taps with acid-resisting materials.—B.

Improvements in Filtering Apparatus. G. Behrus, Lubeck. Eng. Pat. 2168, February 15, 1886. 8d.

FOR the purpose of filtering dust-laden air, the patentee employs a cylindrical collapsible bag, through which the air is either forced by pressure or drawn by suction. To free the dust from the surface of the bag it is caused to suddenly collapse and expand, thus shaking the dust from the surface of the fabric.—C. C. H.

Improvements in Apparatus for Evaporating and Drying Solutions and other substances. O. Klannig, Munich. Eng. Pat. 4042, March 23, 1886. 6d.

THE inventor constructs drying apparatus by employing a horizontal cylindrical vessel, in which revolve concentrically two sets of blades, one within the other, their driving axles projecting through the ends of the cylinder. The larger set of blades revolves at slow speed, touching the inside of the vessel and acting as scrapers; the smaller blades revolve quickly, dipping into the substance to be dried, with which the vessel is partly filled, and throwing it against the sides by centrifugal action. The cylinder is surrounded by suitable heating flues, and provided with openings for filling and emptying, and for the withdrawal of the vapour developed in the drying process.—B.

Improvements in Filters. W. Oldham, Manchester. Eng. Pat. 5880, May 13, 1885. 8d.

THE patentee describes improvements in a filtering apparatus covered by him in Eng. Pat. 7831, 1884. A is a perforated cylinder covered with flannel or other textile fabric. B and C are similar concentric perforated cylinders. The whole rests on a base plate D, and the interior of A communicates with the outlet pipe G; F is a packing preventing leakage of unfiltered liquid into G. The space between A and B is packed with fine animal charcoal, that between B and C with coarse vegetable charcoal, sawdust, or shavings. The filtering units thus

made up are immersed in tank K, containing the unfil-
tered liquid. When any one unit becomes clogged, the whole replaced. The patentee claims (1) the construc-
tion of such units and their combination in groups or

FIG. 3.

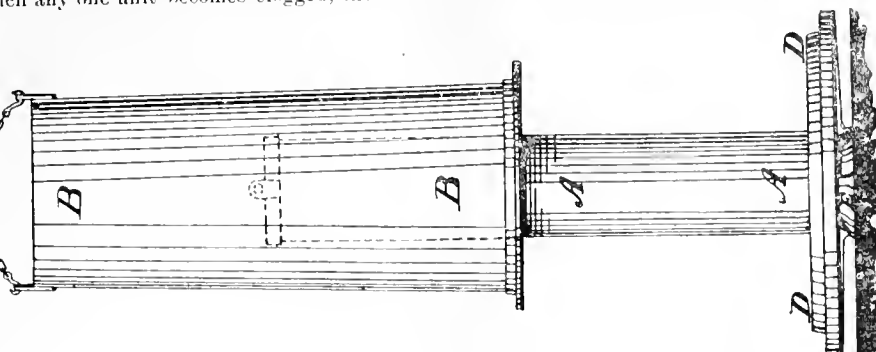


FIG. 2.

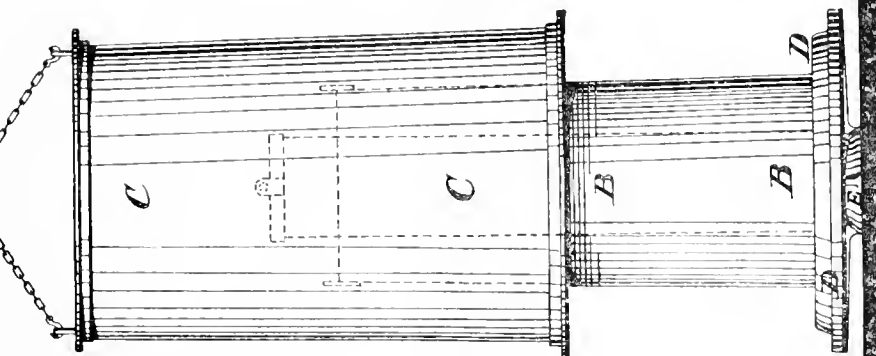
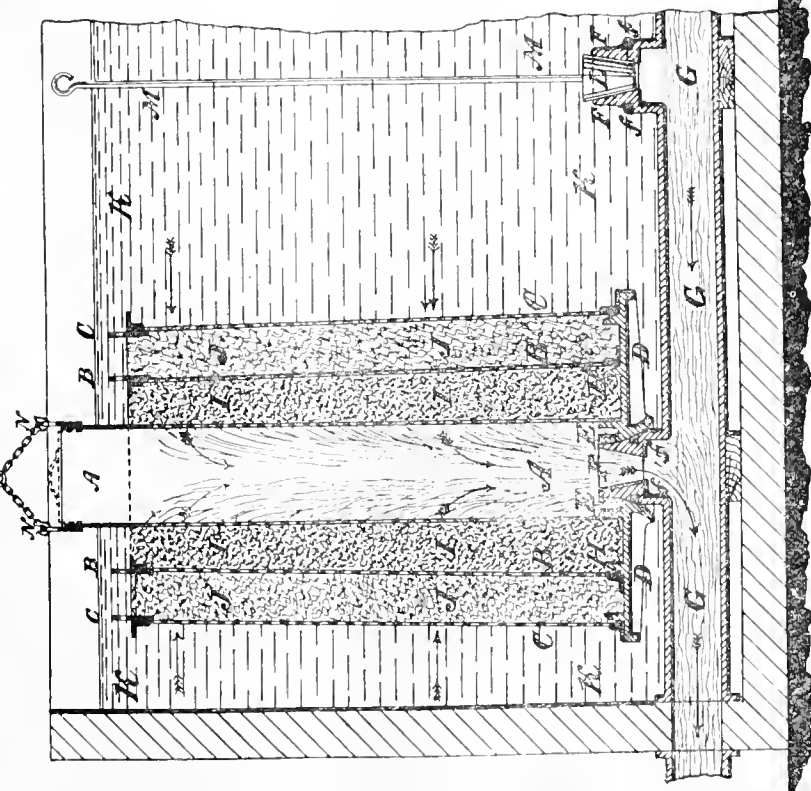


FIG. 1.



centre outlet F is closed by a plug, as shown at L, the
unit withdrawn, the concentric spaces repacked, and the series, (2) the combination of animal and vegetable char-
coal in the apparatus as described.—C. C. H.

II.—FUEL, GAS, AND LIGHT.

The Combustion of Carbonic Oxide and Hydrogen.

Harold Dixon. J. Chem. Soc. (Trans.), 1886, 94—114.

(1.) *Action of Steam on Carbonic Oxide.*—It was shown by the author in 1880 that carefully dried carbonic oxide and oxygen are not exploded by the electric spark, but that a minute trace of water or of a volatile body containing hydrogen determined the explosion; and he brought forward the hypothesis that the steam acts the part of a "carrier of oxygen" by undergoing reductions and successive re-formations; thus: (1) $\text{CO} + \text{H}_2\text{O} = \text{CO}_2 + \text{H}_2$; (2) $2\text{H}_2 + \text{O}_2 = 2\text{H}_2\text{O}$. In the present paper a number of experiments bearing on this point are described. The effect of various substances as regards their power of causing the combination of carbonic oxide and oxygen was first studied. Of the thirteen bodies examined, seven contained hydrogen, and all these were effective; the remainder, which were free from hydrogen, were inactive. The conclusion is drawn that steam acts by virtue of its own peculiar chemical properties, and not as a mere third body.

The author admits that it cannot be directly proved that the steam is chemically changed during the explosion, but shows that the cycle of reactions involved in his hypothesis can occur under the conditions of the experiment, and points out that the hypothesis does not involve the existence of unknown forces. These reactions are (1) the decomposition of steam by carbonic oxide, and (2) the combination of hydrogen and oxygen. The hypothesis has been rejected by Traube on the ground that the first reaction does not take place; Traube assumes that hydrogen peroxide is successively formed and decomposed, thus:—(1) $\text{CO} + \text{H}_2\text{O} + \text{O}_2 = \text{CO}_2 + \text{H}_2\text{O}_2$, and (2) $\text{CO} + \text{H}_2\text{O}_2 = \text{CO}_2 + \text{H}_2\text{O}$. The author then quotes the researches of Groves in 1846 and 1847, in which it was conclusively proved that while carbonic acid is reduced by hydrogen when the gases are heated by a loop of platinum wire, the inverse reaction also takes place, carbonic oxide and steam forming carbon dioxide and hydrogen.

The author has investigated the effect of a coil of platinum wire, heated to various temperatures by a current, on mixtures of carbonic oxide and steam, and of carbonic acid and hydrogen, contained in a eudiometer tube over mercury, and has established the following facts:—The decomposition of steam by carbonic oxide begins at a dull red heat, and the amount of decomposition, which in each case attains a maximum in a few hours, and then becomes constant, increases with rise of temperature up to bright redness, when about 14 per cent. of the carbon monoxide is converted into carbonic acid, an equivalent amount of hydrogen being liberated. The final result is the same when a mixture of equal volumes of hydrogen and carbonic acid is heated by the coil, about 14 per cent. of carbonic acid remaining undecomposed when the coil is heated to bright redness. But if in either case one of the products of the change—the carbon dioxide on the one hand, and the water on the other—is removed, the reaction may be pushed to completion.

The action of induction sparks on a mixture of carbonic oxide and steam is somewhat different, for with moderately powerful sparks not only carbon dioxide but also formic acid is formed, while with very powerful sparks carbon is deposited. With a mixture of carbonic acid and hydrogen, 93·6 per cent. of carbon monoxide was formed, and also a trace of formic acid.

The effect of varying quantities of steam on the combustion of carbonic oxide was studied by saturating the gases at different temperatures, and it was found that the amount of decomposition increased with the quantity of steam present. It has also recently been shown by Nannmann and Pistor (*Ber.* 1885, 2894) that when carbonic oxide and steam are heated in a tube, the reaction takes place at temperatures above about 600°.

The Action of Hydrogen on Oxygen.—It has been observed by Traube that when a jet of burning hydrogen is made to dip into water, hydrogen peroxide is formed, and he concludes that either hydrogen and oxygen unite directly to form hydrogen peroxide, or that the following

reactions occur:—(1) $\text{H}_2 + \text{H}_2\text{O} + \text{O}_2 = \text{H}_2\text{O}_2 + \text{H}_2\text{O}$, and (2) $\text{H}_2 + \text{H}_2\text{O}_2 = 2\text{H}_2\text{O}$. The author confirms Traube's observation, but finds that the same effect is produced by a flame of pure cyanogen, while on the other hand the presence of steam is not necessary for the combustion of this gas. The formation of hydrogen peroxide appears to be due merely to the heating effect of the flame of carbonic oxide or cyanogen, and this conclusion is borne out by the fact that hydrogen peroxide is produced by the rapid evaporation of pure water in the absence of any flame. Again, the most careful experiments show that hydrogen and oxygen, thoroughly dried by phosphorus pentoxide, and perfectly pure, combine at a high temperature, and Berthelot and Vieille (*Compt. Rend.* 95, 151) have shown that the rate of the explosive wave in hydrogen and oxygen is identical with the mean velocity of translation of the steam molecules formed in the reaction, at the maximum temperature of the explosion, and not with the velocity of hydrogen peroxide molecules, or with a velocity intermediate between the two. The author has shown, lastly, that when a mixture of carbonic oxide and hydrogen in any proportion is exploded with a volume of oxygen less than half as great as that of the hydrogen, the pressure being greater than the critical pressure, and the temperature sufficiently high to prevent the condensation of steam, the following relation holds good:—

$$\frac{\text{Vol. of CO} \times \text{vol. of H}_2\text{O}}{\text{Vol. of CO}_2 \times \text{vol. of H}} = 4.$$

But when the quantity of oxygen is greater, this ratio, which he terms the coefficient of affinity, is diminished. The presence of an inert gas such as nitrogen favours the formation of carbonic acid and lowers the coefficient, and the author concludes that the excess of oxygen is inert, the oxidation of carbonic oxide only taking place by means of the steam formed. The presence of inert oxygen is, however, precluded by Traube's hypothesis, and there ought therefore to be no lowering of the coefficient. The same argument tells also against the "contact theory" of the action of steam.

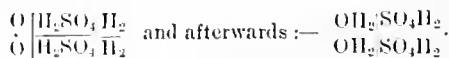
On the other hand, if hydrogen and oxygen combine directly to form hydrogen peroxide, then the lowering of the coefficient should occur when the volume of oxygen is equal to that of the hydrogen.

In conclusion, the author agrees that Prof. Armstrong's views (see next abstract) are not opposed to the observed facts, and points out that his explanation differs only in assuming the simultaneous instead of the successive occurrence of the two reactions.—S. Y.

The Theory of the Interaction of Carbon Monoxide, Water and Oxygen Gases: A Note on Mr. H. E. Dixon's Paper on the Action of Carbonic Oxide on Steam.

Henry E. Armstrong. J. Chem. Soc. (Trans.), 1886, 112—114.

The author suggested in his address to the Chemical Section of the British Association at Aberdeen, that the water may exercise the same kind of action on the oxygen and carbon monoxide as it (or rather the dilute sulphuric acid) does in a Grove's gas battery, and that its hydrogen does not become free in any ordinary sense. In the Grove's gas battery the system before the circuit is closed may be represented thus:—



The state before and after the explosion of a mixture of CO , O_2 and H_2O may be similarly represented, thus:—



The author thinks it conceivable that the influence exerted by the water may be of a mechanical order, that, in fact, it exerts a mere contact action, serving to bring together the carbon monoxide and oxygen which are straining at each other.

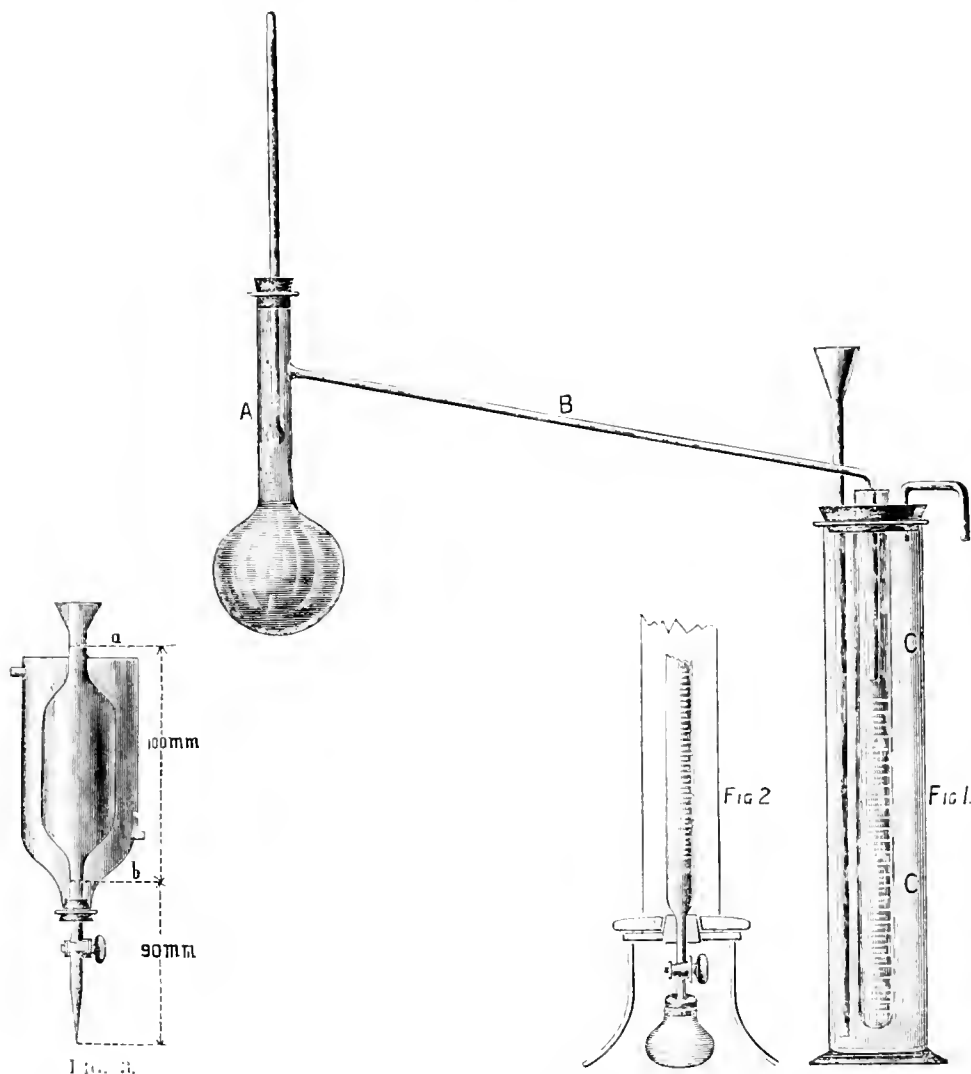
The author thinks that Mr. Dixon's "coefficient of affinity" is explicable by either of their hypotheses, but denies that his conclusion that oxygen is inert towards carbon monoxide follows necessarily from the facts.—S.Y.

Petroleum as an Illuminating Agent. W. Thoerner.
Chem. Zeit. 10, 528—530, 553—554, 573—574, 582—583, 601—603.

On distilling crude petroleum, three fractions are usually collected—viz. (1) the distillate boiling up to 150° C.—i.e., "petroleum-spirit;" (2) the distillate boiling between 150° C. and 300° C.—i.e., the petroleum-oil *par excellence*, "kerosene;" and (3) the distillate boiling above 300° C., which contains the lubricating oils and solid hydrocarbons. The fraction between 150° C. and 300° C.

examination of the oil as to its temperature of distillation. The author uses for that purpose the apparatus shown in the drawings. It consists of a copper flask A (Fig. 1) of about 200cc. capacity, with a neck 12cm. long and 1.8cm. wide, which is connected with a distilling tube B 45cm. long and 0.7cm. wide. The latter is bent at one end, which is introduced into the measuring cylinder, which holds 100cc. up to two-thirds of its height, and is divided in 0.5cc. It is surrounded by a cooling vessel C. For each distillation 100cc. at 15° C. are employed, which are distilled in 25 to 30 minutes. If it be desired to collect the different fractions separately, the modification shown in Fig. 2 is used. Table A on following page contains the results of several experiments.*

The rapidity of flow (viscosity) was determined with the apparatus shown in Fig. 3. The pipette holds 100cc.



being the most valuable, manufacturers try to increase that yield as much as possible by overstepping the limits of the fractionating temperature. Such a proceeding is all the more important to the consumer, as it offers a ready means to the manufacturer of complying with the requirements of the law as regards the flashing point and specific gravity, whereas the illuminating power of the petroleum-oil may nevertheless have been greatly deteriorated. Flashing test and specific gravity offer no guarantee whatever against adulteration and fraudulent admixtures, which can indeed only be detected by an

between the marks *a* and *b*, and the bottom outlet is drawn out to a point 0.8mm. wide. It is surrounded by a cooling cylinder in order to keep the temperature during the experiment at 15° C. From the foregoing table it appears that the percentage of petroleum-spirit has steadily decreased since 1881, whereas the percentage of heavy oils has remained constant. It also shows that manufacturers can easily comply with the requirements of the law as regards flashing test. But

* The author published the results of 71 tests, but it was deemed sufficient to abstract a reduced number.

whether an oil fulfils those conditions which can be fairly expected of a good illuminating oil can only be seen by examining its properties while burning. The following points must hereby be kept in view: Firstly, In what manner does the temperature of the oil in the oil-reservoir of the lamp increase during the burning of the lamp? Secondly, Under what conditions and at what temperature is an explosion of petroleum vapours in the oil-reservoir of the lamp possible? Thirdly, Does the chemical composition of the oil

while at the same time the temperature of the oil in the oil reservoir was gradually raised until it could be ignited, when its temperature was observed. Many experiments proved the interesting fact that the flashing test in the Abel apparatus nearly agrees with the temperature at which the same oil ignites in the oil-reservoir of a burning lamp. These ignitions in most cases take place very quietly and without explosions, the flame of the lamp being extinguished with a hissing noise, while the combustion-gases escape through the

TABLE A.

No.	Specimen of Kerosene Oil	Date.	Flashing Point °C.	Rapidity of flow of 100cc. in seconds.	Fractionated Distillation in volume per cent.		
					Below 150° C.	150–300° C.	Above 300° C.
1	Normal Petroleum	—	27.5	188	5.5	89.0	5.5
4	Kerosene	1881	—	—	16.0	60.0	24.0
16	"	1883	22.2	216	19.1	60.7	19.9
20	"	1883	25.5	232	12.0	62.0	26.0
28	"	1884	33.0	235	8.1	66.0	25.6
36	"Kaiser Oil"	1884	above 35.0	235	2.0	80.0	18.0
37	"Salon Oil"	1884	above 35.0	215	1.0	91.0	5.0
42	"Water White"	1884	above 35.0	210	0.0	95.0	5.0
44	"Standard White"	1884	23.5	239	10.0	54.5	35.5
52	Kerosene	1881	26.0	—	6.0	73.0	21.0
57	"	1881	23.1	—	8.5	67.5	24.0
66	"	1884	23.3	—	9.0	61.5	26.5

TABLE B.

No.	Specimen of Petroleum.	BEFORE BURNING.					AFTER BURNING.				
		Spec. Grav.	Flashing Point, °C.	Chemical Composition: Vol. per cent.			Spec. Grav.	Flash Point.	Chemical Composition: Vol. per cent.		
				Up to 150° C.	150–300° C.	Over 300° C.			Up to 150° C.	150–300° C.	Over 300° C.
1.	Kerosene Oil	0.8065	23.5	8.5	67.5	24.0	0.8063	21.0	9.0	66.5	24.5
5.	"	0.8010	25.8	9.5	64.0	26.5	0.8010	25.5	8.0	66.5	25.5
8.	Kaiser Oil	0.8026	Over 25.0	2.0	80.0	18.0	0.8030	Over 35.0	1.8	80.2	18.0
9.	Salon Oil	0.7967	Over 35.0	1.0	91.0	5.0	0.7967	Over 35.0	1.0	91.0	5.0
11.	Kaiser Oil + 25 petroleum spirit	0.7928	20.7	—	—	—	0.7940	21.2	—	—	—
14.	Petroleum Spirit	0.7528	—	—	—	—	0.7525	—	—	—	—

change during the burning of the lamp, and if so, in what manner? Fourthly, Does the illuminating power of the oil decrease during the burning, and what is the cause of that decrease? Liebermann (*Chem. Zeit.* 6, 925) published an investigation referring to the first point, in which he shows that the rise of the temperature of the petroleum in the oil-reservoir of lamps of the usual construction never amounts to more 9° C., and he concludes that absolute safety against explosions is only given by an oil the flashing point of which lies 9° C. over the maximum temperature of any locality. According to Thoenner's experiments, the difference of temperature between the heat of a room and that of the oil in the lamp varies from 5° to 8° C., and considering that the maximum temperature of a room is rarely as much as 30° C., an oil with a flashing point of 38° C., which is indeed reached by first-class oils (Kaiser oil, salon oil), should give an absolute guarantee against explosive vapours. With regard to investigating the second point, the author constructed a lamp which could be swung to and fro,

openings of the burner-tube. The quantity of oils present boiling between 100° and 150° C. is, however, of great importance, as they are most probably the cause of dangerous explosions owing to their great vapour-tension. Whenever an ignition occurred, the amount of hydrocarbons in the gas mixture never exceeded 3.2 volume per cent., and this small percentage is not likely to produce dangerous explosions. In order to make them practically impossible, the author suggests some improvements in the construction of lamps. On the third point Thoenner's investigations fully agree with those of Junker (*Chem. Zeit.* 7, 650). Oil was burned in a lamp for three hours, and the determinations were carried out directly before and after the burning. Table B above shows the results.

It will be seen that with those kinds of petroleum which contain no more than ten volumes per cent. of oils boiling below 150° C., the combustion of the more volatile products is not faster than that of the higher boiling oils. The specific gravity and flashing point before

and after burning very little, whereas the illuminating power decreases considerably, as will be shown later on. If the oil contains large quantities of petroleum spirit, the illuminating power remains unaltered, although the spirit burns away faster than the less volatile products, but oils containing more than ten per cent. of spirit were not brought into the market these last few years. It can therefore be stated that the chemical composition of the usual brands of kerosene oil does not change during the burning. As to the fourth point, a large number of photometric tests were made, comparing by means of the same lamp different oils with regard to their illuminating power and consumption of oil. Thus it was clearly proved that a large percentage of petroleum spirit considerably increases the illuminating power of an oil, whereas the presence of considerable quantities of heavy oils has the opposite effect. Generally speaking, the illuminating power of an oil decreases more or less after a few hours' burning in the lamp; the decrease being greater the less the height of the oil in the oil-reservoir, and the higher the percentage of heavy oils in the petroleum. The presence of a large quantity of volatile oils causes not only a high illuminating effect at the beginning, but also a slower decrease of it during the first few hours. The heavy oils are not so easily drawn up by the wick as the lighter ones, and the former consequently char the wick. In order to obtain a regular and uniform illuminating effect it is necessary to construct lamps with an oil-reservoir in which the oil remains at a constant level. The lamp patented by Mr. Witting, of Osnabruck, fulfils this condition.—S. H.

Improvements in Carburetted Apparatus. O. W. Bennet, Washington, Columbia. Eng. Pat. 2258, February 16, 1886. 8d.

A CYLINDRICAL vessel contains a vertical tube centrally situated with regard to the main cylinder, and communicating with the interior of the same by means of a perforated bottom. The upper portion of the main vessel is utilised as a reservoir for the hydrocarbon used. The lower portion is divided into two or more chambers, so connected that when the uppermost is filled to a certain depth the liquor overflows into the next, and finally finds its way into the central tube, where it carries a float regulating the supply of hydrocarbon from the reservoir to the topmost chamber. Air is admitted at the bottom and passes upwards through each of the chambers in turn, playing over the surface of the hydrocarbon therein, and emerging from the topmost chamber impregnated with the hydrocarbon vapours.—A. R. D.

Improved Construction of Carburetted Apparatus for Burning Coal Gas with Hydrocarbons. H. E. A. Wallis, London, and H. T. Ratcliffe, Birmingham. Eng. Pat. 9650, February 27, 1886. 8d.

THE carburetter is a vessel constructed with a kind of hollow lip extending from its main body. Immediately beneath this is the burner. Outside the carburetter, and so disposed as to receive heat from the burner, is a double pipe, arranged to deliver gas either into the body of the carburetter or into the hollow lip whence the outlet pipe issues. Thus the gas entering is heated by its passage through the double pipe, and playing over the surface of the hydrocarbon in the carburetter is impregnated with its vapour. It is then heated still more strongly by passing through the hollow lip to the burner. This second heating secures great steadiness of flame, as well as preventing deposit in the outlet pipe.—A. R. D.

Improvements in Apparatus for Enriching Illuminating Gas. Jas. Parkes, Aston. Eng. Pat. 2950, March 1, 1886. 8d.

THESE improvements mainly refer to the apparatus described in Specification No. 454, 1886. The delivery pipe is carried from the upper portion of the carburetting vessel, and just at the point of exit is considerably widened out so that it may receive the full heating

effect of a gas jet placed immediately below. The supply of gas to this burner is controlled by a separate tap. In this way sufficient heat reaches the carburetter to vapourise its hydrocarbon contents, while the enriched gas, passing away, is made so hot that risk of deposit in the pipes is avoided.—A. R. D.

Improvements in Apparatus for the Production and Utilisation of Vapour Fuel. W. P. Thompson, Liverpool. From A. J. Ambler, Washington, Columbia. Eng. Pat. 4046, March 22, 1886. 11d.

THIS invention is for mixing petroleum with steam, and heating the resulting vapours to form a homogeneous heating gas. It is particularly applicable to locomotive engines. For details the Blue Book and its drawings must be consulted.—A. R. D.

Improvements in Apparatus for Mixing and Heating Materials for the Manufacture of Patent Fuel. S. Butler, Cardiff. Eng. Pat. 7791, March 26, 1886. 6d.

THIS apparatus combines processes employing "steam" and "dry heat." The material leaving the steam "pug" of the ordinary kind is worked by an Archimedean screw into a slowly revolving heated iron cylinder, in which it is caused to travel forward by a mechanical stirrer. Another form of drying apparatus consists of a firebrick cylinder provided with a central shaft and mixing arms. A heating flue runs spirally round the cylinder.

—A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

The Action of Heat on Liquid Paraffins. L. M. Norton and C. W. Andrews. Amer. Chem. J. 8, No. 1—9.

THE hydrocarbons employed in this research were obtained from petroleum by careful fractionation, and subsequent treatment with bromine, and with nitric acid, the product being finally again fractionated. The vapours of the hydrocarbons were passed through a glass or porcelain tube heated in a combustion furnace, the products of the decomposition being passed first through a cooled receiver to condense any liquid products and the uncondensed gases through ammoniacal cuprous solution, dilute acetic acid, and finally through a solution of bromine in carbon bisulphide. In no case was there more than a slight precipitate in the ammoniacal cuprous solution. The condensed liquid hydrocarbons were fractionated, the different portions treated with bromine, and the products distilled under very low pressure. The bromides from the absorption flasks, after being freed from excess of bromine and from carbon bisulphide, were also distilled under low pressure, when a non-distillable tarry mass remained, containing, however, a solid bromide, which was extracted with alcohol.

Normal Hexane.—The liquid decomposition products from this contained some undecomposed hexane, amylene, hexylene, and benzene, together with a very little saturated hydrocarbon boiling between 160 and 160°, and some tar. The cuprous solution contained only traces of a precipitate. The products in the absorption flasks contained ethylene and propylene bromides in nearly equal quantities, and a solid bromide $C_{11}H_{16}Br_2$, melting at 112°. Gases were also produced which were not absorbed by bromine. On repeating the experiment at a lower temperature (about 700°) the products were propylene, butylene, amylene, hexylene, butane (*i.e.*, $C_{11}H_{16}$), and gas not absorbed by bromine.

Isoheptane.—The decomposition of this hydrocarbon at a red heat gave ethylene, propylene, butylene, amylene, hexylene, butane (apparently different from the above, as the bromide melted at 107.5°), and gases not absorbed by bromine.

Normal Pentane.—The products of the decomposition of normal pentane at a red heat were ethylene, propylene, butene (the bromide melted at 113°), traces of other unsaturated hydrocarbons and gases not absorbed by bromine.—A. K. M.

The Decomposition and Genesis of Hydrocarbons at High Temperatures. H. E. Armstrong and A. K. Miller. J. Chem. Soc. 1886, 74—93.

IN this paper the authors describe the results of their examination of the various products of the decomposition of petroleum in the manufacture of oil-gas (this Journal, 1884, 462), the products examined being the portion of the compressed gas which combines with bromine, the liquid deposited during compression of the gas to about ten atmospheres, and the portion of the tar which is volatile in steam.

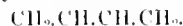
The liquid deposited during compression of the gas contains hydrocarbons of the C_nH_{2n} and C_nH_{2n-2} series, benzenes, and a very small proportion of hydrocarbons not attacked by sulphuric acid; the latter are more abundant in the steam distillate from the tar.

I. Benzenoid Hydrocarbons.—In order to separate these from the unsaturated hydrocarbons, the crude liquid is cautiously agitated, first with moderately dilute sulphuric acid (2 vols. acid and 1 vol. water), and subsequently with a stronger acid (4 vols. acid and 1 vol. water). Much heat is evolved during this treatment, and the unsaturated hydrocarbons are converted into polymerides, which are left behind when the product is distilled in steam. On surrounding the distillate by a freezing mixture, a large quantity of benzene crystallises out, and after fractioning the mother-liquor from the crystals, a further crystallisation may be effected by freezing the fractions, boiling at about 80°. The benzene thus obtained should be purified by treatment with alkaline permanganate, bromine or sulphuric acid, fractionally distilled, and again crystallised. The residual hydrocarbon from which the benzene has been separated is next agitated with hot concentrated sulphuric acid to extract the remaining benzenoid hydrocarbons, and these are then recovered by hydrolysis (*Chem. Soc. Trans.* 1884, 148). The residue undissolved by the sulphuric acid is treated finally with weakly fuming acid, and after distillation in steam forms a brilliant colourless liquid having the characteristic odour of a pure paraffin. This method of separating the benzenoid hydrocarbons and those insoluble in sulphuric acid is of course applicable either to the crude mixture as a whole or to separate fractions. To isolate the toluene fractions of the hydrolysed product boiling below 115° (after separating as much benzene as possible) are fractionally treated with hot concentrated sulphuric acid and the toluene sulphonic acid purified with the help of its potassium salt, from which the hydrocarbon is recovered by hydrolysis. The three xylenes were separated by Jacobsen's method (*Ber.* 10, 1009) from the fraction boiling at 135—145°, and appear to be present in about the same relative proportions in which they ordinarily occur in coal-tar xylene. Mesitylene and pseudocumene were separated by dissolving the fraction 155—175° in sulphuric acid, and submitting the product to fractional hydrolysis; they appear to be also present in about the same relative proportions in oil-gas tar as in coal tar. Fractions 180—190 and 190—200° were separately converted into sulphonic acids, from which barium salts were prepared. The composition of the salt from the lower fraction indicated the presence of a $C_{10}H_{14}$ hydrocarbon, whilst that from the higher fraction corresponded with a $C_{11}H_{16}$ hydrocarbon.

A large quantity of naphthalene separated from the fractions collected above 200°, and after its removal comparatively little hydrocarbon was left. All attempts to detect the presence of diphenyl failed.

II. Hydrocarbons of the C_nH_{2n-2} Series.—The crude liquid obtained during compression of the oil-gas gave off volumes of gas when warmed, and when this was passed through bromine, and the product steam-distilled, a heavy oily distillate was obtained, whilst the residue in the flask solidified on cooling. The latter substance, after purification, was found to have the composition of Caventon's crotonylene tetrabromide $C_4H_6Br_4$; it crys-

tallised in small glistening plates, melting at 116°. The same product was also obtained directly from the oil-gas by passing it through bromine, but in this case it is accompanied by a much larger proportion of oil. When the crotonylene tetrabromide is submitted to the action of the zinc-copper couple, gaseous crotonylene is set free, and when this is oxidised by a 2 per cent. permanganate solution, formic acid, unaccompanied by any higher fatty acid, is produced; from this it is concluded that the crotonylene is dimethylene-ethane or vinyl ethylene



Another hydrocarbon of the C_nH_{2n-2} series was obtained from fractions of the original crude liquid boiling at about 40°; these fractions were brominated and the product steam-distilled as before; and a solid tetrabromide, $C_5H_8Br_4$, was obtained from the residue. It crystallised in long, thin, narrow prisms, melting at 115°. The hydrocarbon, separated by means of the zinc copper couple, boiled at about 45°, and on oxidation with permanganate, yielded formic and acetic acids only. From this and from the fact that the hydrocarbon is not a true acetylene, it is concluded that it must be either isoallylethylene, symmetrical dimethylallene or unsymmetrical dimethylallene; the authors are inclined to select the first of these as being the most probable, from the simple relation which this bears to normal amylene, from which the unsaturated hydrocarbon is probably derived.

III. Hydrocarbons of the Olefine Group.—The method employed for detecting these hydrocarbons depends upon the fact that a normal olefine is converted by oxidation into formic acid and a fatty acid containing one carbon atom less than the hydrocarbon yielding it. Thus the fraction containing normal amylene should yield butyric acid, that containing normal hexylene, valeric acid, etc. The appropriate fractions were oxidised with permanganate, the product acidulated with sulphuric acid, and the volatile acid separated by steam-distillation; the distillate neutralised with sodium carbonate, concentrated and fractionally precipitated with silver nitrate. The silver salts were purified, analysed, and finally converted into calcium salts. In this way normal butyric, normal valeric, and normal caproic acids were obtained, these indicating the presence of amylene, hexylene, and heptylene. No indication of any higher olefine could be found. Lower olefines, if present, should naturally occur in the oil-gas itself, and were, therefore, looked for in the liquid bromide which, as already mentioned, was separated by steam distillation from the solid crotonylene tetrabromide. On fractioning this oil, the greater part was found to be ethylene bromide, but contained also propylene bromide. A relatively small quantity of oil of higher boiling point was present, and in order to test this for butylene, it was oxidised with permanganate, and the product examined by Linnemann's method (*Annalen*, 160, 222) for propionic acid. Nothing but acetic and formic acids were, however, discovered. The presence of butylene in oil-gas is, therefore, very doubtful, and the authors are of opinion that the substance discovered by Faraday amongst the oil-gas products, and thought by him to be butylene, was really crotonylene.

IV. Hydrocarbons insoluble in Sulphuric Acid.—The method of separating these from other hydrocarbons has been mentioned above. They are contained almost exclusively in the higher fractions (boiling above 150°) of the steam distillate from the oil-gas tar. The composition of the different fractions (from 160° to 205°) agrees closely with the general formula C_nH_{2n} , and the density determinations also agree approximately with those given by Markownikoff and Oglobine (*Ann. Chim. Phys.* 1884 [6], 2, 372) for the C_nH_{2n} hydrocarbon found in Russian petroleum. Hence the portion insoluble in sulphuric acid is probably a mixture of these with true paraffins.—A. K. M.

Naphthylhydrazines. E. Fischer. *Annalen*, **232**, 236—243.

α-Naphthylhydrazine.—50grms. of finely-powdered *α*-naphthylamine are mixed with 450grms. of hydrochloric acid (sp. gr. 1.1) and treated with the equivalent

quantity of sodium nitrite. The mixture is filtered and the dark-brown solution added to 250grms. of stannous chloride dissolved in cold hydrochloric acid. The mass is then warmed until the greater part of the precipitate dissolves and a nearly colourless solution is obtained. On cooling, hydrazine hydrochloride is deposited as a crystalline mass, and on adding sodium hydroxide to a hot aqueous solution of the hydrochloride, hydrazine is obtained, which may be purified by recrystallisation from alcohol and ether, and rapid crystallisation from hot water. The base boils at 203°, melts at 116–117°, forms laminar sparingly soluble in ether and alcohol, but readily soluble in benzene and chloroform. Crystallisable salts are formed with mineral acids (the acetate is decomposed by water). Naphthylhydrazine closely resembles phenylhydrazine in its reactions. With pyroacetic acid it yields *α*-naphthylhydrazinepyroacetic acid $C_{10}H_7N_2H \cdot C(CH_3)(CO_2H)$, forming yellow needles melting at 159°; with acetone, *acetone-α*-naphthylhydrazine $C_{10}H_7N_2H \cdot C(CH_3)_2$, crystallising in colourless masses melting at 74°—insoluble in water, readily soluble in alcohol, ether, acetone, and benzene. *Diazonaphthalenimine* appears to be formed when dilute nitrous acid is added to the base. *β*-naphthylhydrazine prepared like the *α*-compound melts at 124–125°, crystallises in laminar, is sparingly soluble in ether, but dissolves freely in hot alcohol, benzene, and chloroform. It oxidises less readily on exposure to the air than the *α*-compound, and forms crystallisable salts exhibiting the same properties as the *α*-derivative.—D. B.

Action of Sulphuric Acid on Durene, and Formation of a New Tetramethylbenzene. O. Jacobsen. Ber. 19, 1209–1217.

In continuing his researches on durene (this Journal, 1886, 25), the author found that by the action of sulphuric acid only a small proportion of the hydrocarbon is converted into duresulphonic acid, hexamethylbenzene and the sulphonic acids of liquid hydrocarbons being formed. After converting the sodium sulphonates into the corresponding sulphonamides the latter were subjected to fractional crystallisation from alcohol, the following compounds being obtained: (1.) An amide melting at 187° and crystallising in prisms with a vitreous lustre, sparingly soluble in alcohol. (2.) An amide melting at 170–172° and crystallising in needles more readily soluble in alcohol. (3.) An amide readily soluble in alcohol melting at 110–116°, and resembling 1:2:3 metaxylenesulphonamide. On heating these compounds with hydrochloric acid at 170–180°, the least soluble amide yielded a liquid hydrocarbon which was found to be a new tetramethylbenzene. The more soluble amides yielded exclusively pseudocumene.

Prehnitene $C_6H_4(CH_3)_4$ [$CH_3 : CH_3 : CH_3 : CH_3 = 1 : 2 : 3 : 4$] is a liquid hydrocarbon boiling at 204°. At a low temperature it solidifies to a crystalline mass which melts at –4°. *Dibromoprehnitene* $C_{10}H_8Br_2$ is sparingly soluble in alcohol, readily soluble in toluene. It crystallises in long colourless prisms melting at 210°. *Dinitroprehnitene* $C_{10}H_6(NO_2)_2$ crystallises from alcohol in yellowish-white prisms having a vitreous lustre, sparingly soluble in cold, readily soluble in hot alcohol. It melts at 178°. *Prehnitene-sulphonic acid* $C_{10}H_7SO_3H$ is obtained by dissolving the hydrocarbon in warm sulphuric acid. The barium and sodium salts are also described. The *sulphonamide* $C_{10}H_7SO_2NH_2$ forms small prisms melting at 187°. *Prehnitylic acid* $C_6H_4(CH_3)_4CO_2H$ is formed by the action of dilute nitric acid on prehnitene. It crystallises from alcohol in long transparent prisms having a vitreous lustre and melting at 167.5°. The *calcium salt* $[C_6H_4(CH_3)_4CO_2]_2Ca (+4H_2O)$ is described. When distilled with an excess of lime it yields a hydrocarbon boiling at 170°, which proved to be hemellithene. Prehnitylic acid is therefore a mono-carboxylic acid of hemellithene of the constitution $C_6H_4(CH_3)_4COOH$.—D. B.

Pseudocumene- and Bromopseudocumene-sulphonic Acids. O. Jacobsen. Ber. 19, 1218–1223.

Monobromopseudocumene-sulphonic acid $C_6H_4(CH_3)_2SO_3H.Br$ [1:3:4:5:6] is formed by sulphonating pure crystallised monobromopseudocumene. The sodium salt is sparingly soluble in cold water, and crystallises in flat needles or scales with a vitreous lustre. The calcium salt forms fine needles sparingly soluble in water. The sulphonamide is almost insoluble in water and crystallises from alcohol in needles melting at 186°. *Pseudocumene-sulphonic acid* $C_6H_4(CH_3)_3SO_3H$ [1:3:4:5] is obtained by reducing the sodium salt of the preceding sulphonic acid with ammonia and zinc dust. The barium and sodium salts are described. The *sulphonamide* $C_6H_4(CH_3)_3(SO_2NH_2)$ [1:3:4:5] is readily soluble in alcohol and crystallises in thin prisms melting at 172°. *Pseudocumenol* $C_6H_4(CH_3)_3OH$ [1:3:4:5] is formed by fusing sodium pseudocumenesulphonate with caustic potash. It crystallises in long prisms, melts at 95°, and boils at 230–231°. *Dibromopseudocumene* crystallises from hot alcohol in beautiful long yellowish-white needles melting at 152°. *Dibromopseudocumene* $C_6H_4(CH_3)_2Br_2$ [1:3:4:5:6] is obtained by further bromination of the mono-derivative. A mixture of mono, di- and tribromopseudocumene is formed, from which the dibromo-compound is separated by fractional distillation and crystallisation from alcohol. It melts at 63–64° and boils at 293–294°. *Dibromopseudocumene-sulphonic acid* $C_6H_4(CH_3)_2Br_2SO_3H$ [1:3:4:5:6:2] is obtained by heating dibromopseudocumene with sulphuryl monochlorhydride. A mixture of tribromopseudocumene and dibromopseudocumenesulphonic acids is formed, which is treated with alcoholic soda lye and boiled with a large quantity of water. Tribromopseudocumene remains in the residue, whilst sodium dibromopseudocumenesulphonate crystallises out, the mother-liquors on evaporation yielding the mono-bromo-compound. The sodium and barium salts were prepared. The sulphonamide crystallises from hot alcohol in slender rhombic laminar. By treating the sodium salt with ammonia and zinc dust, *sodium pseudocumene-sulphonate* $C_6H_4(CH_3)_3SO_3Na$ [1:3:4:2] is obtained. It is readily soluble in water and crystallises in flat needles. Its *sulphonamide* $C_6H_4(CH_3)_3(SO_2NH_2)$ [1:3:4:2] is identical with the second pseudocumenesulphonamide obtained from durene. It forms needles melting at 113°, and yields pure pseudocumene when heated with hydrochloric acid at 170°. The *pseudocumenol* $C_6H_4(CH_3)_3OH$ [1:3:4:2] obtained by fusing the sodium salt with potash, is a solid substance which crystallises in long needles. It gives no colour reaction with ferric chloride, melts at 62° and boils at 232–234°. The *sodium monobromopseudocumenesulphonate* $C_6H_4(CH_3)_2Br.SO_3Na + \frac{1}{2}H_2O$ [1:3:4:5:2] obtained from dibromopseudocumene together with the salt of the dibrominated acid, crystallises in scales of pearly lustre. The sulphonamide is readily soluble in alcohol, and forms long needles melting at 158°. By debrominating the sodium salt the corresponding salt of pseudocumenesulphonic acid is obtained. Its sulphonamide melts at 113°, and yields a liquid monobromopseudocumene when heated with hydrochloric acid at 170°. This compound boils at 236–238°, and does not solidify at –10° to –15°.

—D. B.

Improvements in Coke Ovens and in Methods of and Apparatus for Collecting the Products of Combustion from such Coke Ovens. A. M. Chambers and T. Smith, York. Eng. Pat. 7358, June 16, 1885. 8d.

IMPROVEMENTS in the ovens and apparatus described in a previous patent (No. 4708, March 11, 1884; this Journal, 1885, 49). A fire-clay pipe is arranged round the upper part of the oven close to the fire-brick lining of the same, so that it becomes sufficiently highly heated, and one of the ends of this pipe is brought forward and connected with an air-supply pipe arranged in front of the oven, into which air is forced at a moderate pressure. The inner end of the pipe, after passing round the oven, is directed inwards through the front wall of

the oven and slightly upward, so that the current of heated air forced in is directed upward across the oven without coming into contact with the surface of the coking coal. By this arrangement gas is not admitted into the oven, as the heated air forced through the pipe into its upper part is sufficient to carry on the carbonising process. Novel arrangements relating to the different parts of the apparatus for condensing, washing and separating the products of distillation are described also in the specification.—D. B.

Improvements in Apparatus for Distilling Shale or other Mineral Oil or Petroleum. N. M. Henderson, Broxburn. Eng. Pat. 13,014, October 29, 1885. 8d.

IN treating crude oils obtained by the destructive distillation of shale or similar substances, an apparatus of the kind described in Patent 540, of 1883, is employed (this Journal, 1883, 474) with the following modifications:—The apparatus consists of a primary still which is connected with two secondary stills, one on each side. Each of the secondary stills is again connected by pipes and valves with two or more coking stills, which are used in rotation, one being cleaned whilst the other is in use. In the primary still the oil enters by a vertical feed-pipe dipping just below the surface of the oil, whilst in each secondary still the oil enters by a horizontal pipe situated at a short distance above the top of the concavity of the still bottom, the pipe entering one end of the still and delivering the oil near the other end. As the volatile part of the oil is distilled off, the remaining oil becoming heavier descends to the deep sides of the bottom of the still, the fresh oil continually fed in being lighter and remaining at the top. The deep bottoms communicate through outlet valves with external piping, which has branches leading up to the feed-pipes of the secondary stills. The latter are subjected to a higher heat than the primary stills. From the deep sides of the secondary stills the heavier oil passes off to external piping and to one or other of the coking stills.—D. B.

Improvements in Apparatus and Arrangements for Distilling Mineral Oils. W. M. Fraser, Mid Calder. Eng. Pat. 4094, March 24, 1886. 6d.

THE object of this invention is to simplify and improve the existing processes for distilling oils more especially in their crude state as obtained from the retorts and when fractionation is not required. In the improved apparatus the oil is operated upon continuously, so that increased quantities may be attacked with apparatus of diminished cost and with reduced working expenses. The heat for the distilling apparatus is supplied by a furnace of the form described in a previous patent obtained by the inventor (No. 15,686 of 1885). The main part of the improved distilling apparatus is a horizontal cylindrical vessel supported and enclosed with brickwork constructed with suitable heating flues. The arrangement of these flues cannot be described without reference to the drawings which accompany the specification; they are, however, so constructed that the apparatus is said to be rendered free from the liability which exists in ordinary stills for coke or residuary carbonaceous matter to be deposited on the bottom.—D. B.

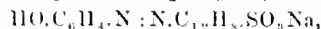
IV.—COLOURING MATTERS AND DYES.

Amidodiphenylsulphonic Acid and Azo-dyes from Diphenyl. Thomas Carmelley and James Schleselman. J. Chem. Soc. (Trans.), 1886, 380—383.

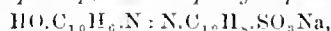
Two methods may be adopted in the preparation of dyestuffs from diphenyl. (1) The combination of a hydroxydiphenyl or its sulphonic acid with a diazo-compound, thus:— $C_{12}H_{10}(OH).N:N.X.SO_3H$ or $C_{12}H_9(SO_3H)(OH).N:N.X$, etc.; (2) the sulphonation of amidodiphenyl, diazotisation of the resulting amidodiphenylsulphonic acid, and combination of the diazo-sulphonic acid with a phenol, amido-compound, etc.,

thus:— $C_{12}H_9(SO_3H).N:N.X.OH$. Of the two methods the latter only gave good results. By conversion into the nitro-compound, and subsequent reduction with nascent hydrogen 60grms. of pure diphenyl, melting at 70.5°, gave 16grms. of pure paramidodiphenyl with the melting point 49°. The sulphonic acid $C_{12}H_9(NH_2).SO_3H$ (probably $NH_2.C_6H_4.C_6H_4.SO_3H = 1:4:1:4$) was prepared by heating one part of the amidodiphenyl with 4 parts of strong sulphuric acid to 130° for half-an-hour, and pouring the product into water. It melts above 300° with decomposition. The sodium and barium salts were prepared and analysed. The method of preparation of the dyes is as follows:—The sulphonic acid from 2grms. of amidodiphenyl, after admixture with 2cc. strong hydrochloric acid and 20cc. water, was diazotised by the addition, with frequent stirring, of 1gm. of potassium nitrite dissolved in 3cc. of water. A cold alkaline solution of the phenol was then added gradually with constant stirring.

Sodium phenolparadiazodiphenylsulphonate—



forms an amber-coloured precipitate soluble in warm water; it dyes wool and silk a brilliant yellow, imparts an amber shade to raw jute, but has no affinity for bleached jute yarn. *Sodium resorcinolparadiazodiphenylsulphonate*, $(HO)_2C_6H_3.N:N.C_{12}H_8.SO_3Na$, is a deep brick red precipitate which becomes yellowish brown on drying. It dissolves readily in hot water, and dyes silk, wool, and raw jute a beautiful orange, but has little affinity for bleached jute. *Sodium quinolparadiazodiphenylsulphonate*, $(HO)_2C_6H_3.N:N.C_{12}H_8.SO_3Na$, dissolves easily in cold water and is not precipitated even by salt. It dyes silk and raw jute a golden amber. *Sodium a-naphtholparadiazodiphenylsulphonate—*



is a very deep red precipitate fairly soluble even in cold water. It dyes silk, wool and raw jute a deep reddish brown. *Sodium β-naphtholparadiazodiphenylsulphonate*, $HO.C_{10}H_7.N:N.C_{12}H_8.SO_3Na$, is a bright red precipitate soluble in hot water. It dyes silk, wool and raw jute a very brilliant red, and bleached jute yarn a reddish pink shade. The barium salts of these dyes were prepared and analysed. All the above dyes are fast colours on wool and silk, and are not affected by boiling water, or a boiling half per cent. soap solution, except the yellow dye from phenol, which becomes slightly paler, and the dye from a-naphthol, which becomes a purer brown.—S. Y.

Nitration of Dimethylaniline. E. Nörling. Ber. 19, 545.

THE present paper confirms results obtained by Groll (Ber. 19, 198, and this Journal, 1886, 319)—viz., on nitrifying dimethylaniline, a para- and a meta-nitro-compound are formed. The author in his previous investigation on this subject had omitted to neutralise the mother-liquor from which the para-compound separates, and which contained the whole of the meta-derivative in the form of a nitric acid salt.—J. B. C.

Isomeric a-Naphthylaminesulphonic Acids. O. N. Witt. Ber. 19, 573.

IF a-naphthylamine be treated with sulphuric acid, a sulphonic acid corresponding to that first obtained by Piria results. If, on the other hand, the hydrochloride of a-naphthylamine be added in small portions at a time to fuming sulphuric acid (20—25 per cent. SO_3) and cooled, an acid is obtained, the sodium salt of which is four times as soluble in water as Piria's naphthionic acid. Its several reactions with metallic salts indicate that a new acid is present, to which the author gives the name of naphthalidinesulphonic acid. The azo-derivative with β-naphthol, corresponding to roccelin, is of a less yellow shade, and much less soluble in water. The author has prepared Cleve's naphthylaminesulphonic acid by reducing the nitrosulphonic acid, and finds that

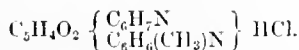
although exceedingly like in properties to his naphthalidenesulphonic acid, identity has not been established. For the acid of Cleve, the author suggests the name of amidonaphthalenesulphonic acid. To determine the constitution of these isomerides, Cleve acted upon naphthionic acid with PCl_5 and obtained β -dichloronaphthalene (melting-point 67.5°), to which the position $\alpha_1 \alpha_2$ has been given. As the same amidonaphthalenesulphonic acid is obtained from a nitro-compound prepared by nitrifying α -naphthalenesulphonic acid, or by sulphoning naphthalene, it is probable that both side chains are in the α position. As the positions $\alpha_1 \alpha_2$ are attached to naphthionic acid, the latter sulphonic acid must contain side chains in two rings as follows:— $(\text{SO}_3\text{H} : \text{NH}_2 = 1 : 4)$ and $(\text{SO}_3\text{H} : \text{NH}_2 = 1' : 4)$ —naphthionic acid and amidonaphthalenesulphonic acid. The constitution of the third isomeride naphthalidinesulphonic acid, is not definitely settled.—J. B. C.

Colouring Matters from Furfuraldehyde. Hugo Schiff. Ber. 19, 847—849.

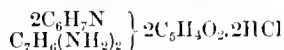
ON warming β -naphthylamine with furfuraldehyde, the compound β -furfuronaphthylamine $\text{C}_{15}\text{H}_{17}\text{N} : \text{CH}_2\text{C}_4\text{H}_3\text{O}_2$ is formed, which crystallises from alcohol in colourless glittering plates, melting at 85° . The hydrochloride forms golden-yellow needles, soluble in alcohol with a deep red colour. The author has proved that *secondary*, as well as *primary*, aromatic bases are capable of yielding colour-forming bases with furfuraldehyde, giving as an example, the methylaniline compound—



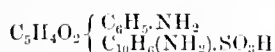
the hydrochloride of which forms fine violet crystals, melting at 94° . *Tertiary* aromatic bases, however, do not directly react with furfuraldehyde. Two different bases can combine at one and the same time with furfuraldehyde, such as primary and secondary bases, or monamines and diamines, the following bodies being thus obtained:—*Monomethylanilinefurfuraniline hydrochloride*—



Toluylenediaminedifurfuraniline hydrochloride—



These and similar bodies dissolve in alcohol with red to bluish-violet colourations, their crystals having a bronzy metallic appearance similar to that possessed by magenta. Compounds resembling these mixed bodies, obtained from different bases with furfuraldehyde in the presence of hydrochloric acid, are also obtained from the aniline salts of aromatic amido-acids, the necessary acid for the reaction being supplied by the amido-acid itself; thus from aniline naphthionate the body



anilinefurfuronaphthionate is formed. Neither pyromucic acid, pyromucamide, anilinepyromucate, furfurine, nor pyromucanilide (melting-point 123.5°) form, with aromatic bases or amido-acids, any colouring matters, but the reverse is the case with thiofurfuraldehyde and hydrofurfuramide. The reaction takes place therefore solely in the aldehyde group, the doubly united oxygen molecule being replaced by two aromatic basic groups.

—T. L. B.

Benzenetrisulphonic Acid. C. Loring Jackson and John F. Wing. Ber. 19, 898—902.

FIVE parts of potassium benzene-meta-disulphonate (or of the monosulphonate) are mixed in a porcelain dish with six parts of ordinary strong sulphuric acid, and gently heated till the salt has dissolved and the water of crystallisation has evaporated; heavy white vapours of sulphuric acid then begin to be evolved, and soon the mass becomes pasty and swells up. The reaction is then

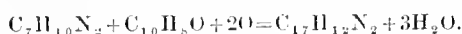
finished, and the dark mass at once is dissolved in water, the sulphuric acid neutralised with barium carbonate, and the potash salt of the trisulphonic acid formed, evaporated down and crystallised. Experiment shows that the formation of the trisulphonic acid is due to the action of the acid potassium sulphate; aluminium sulphate acts in a similar manner, but less satisfactorily. By heating the potash salt with three molecules of potassium cyanide, a nitril was obtained, which, on saponification, produced *trimesic acid*, $\text{C}_6\text{H}_2(\text{COOH})_3$. Fusion with caustic soda gave *phloroglucinol*. This benzenetrisulphonic acid possesses, therefore, symmetrical (1.3.5) constitution.—T. L. B.

On the Action of Sodium on Tribenzylamine. C. Loring Jackson and John F. Wing. Ber. 19, 900—902.

DRY tribenzylamine, mixed with rather more than half its weight of sodium, was heated in a retort on a paraffin bath. The sodium began at 150 — 160° to assume an intense purple colouration, which reached its maximum at 190 — 200° , at which temperature the mixture was heated for two or three hours. During the operation a hydrocarbon distilled over, which was found to consist of *toluene* mixed with about 8 to 10 per cent. of *benzene*. The distillate amounted to 48 to 56 per cent. of the weight of tribenzylamine used. The residue in the retort, besides unattacked sodium and tribenzylamine, consisted of *sodium cyanide* (amounting to 25 per cent. of the total yield), *lephim*, and *blue* and *brown* colouring matters.—T. L. B.

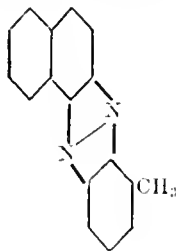
The Eurlhodines. Otto, N. Witt. Ber. 19, 914—918.

BY the action of nitrite of amyl on eurlhodine, a substance was obtained melting at 156° , which possessed the unmistakable character of a quinoxaline (comp. this Journal, 1886, 320), but differed in its properties from that obtained by Hinsberg, which melts at 139 — 142° . On repeating the experiment with ethyl nitrite, a substance was obtained which melted at 175° . This difference in the result led to the idea that the alcohol radical had entered into the molecule of the new compound. The analysis of the substance fully confirmed this, the body being the *ethyl ether* of an eurlhodol, $\text{C}_{17}\text{H}_{11}\text{N}_2\text{O} \cdot \text{C}_2\text{H}_5$. It is a very similar substance to eurlhodine. Crystallised from alcohol and glacial acetic acid, it forms brilliant pale lemon-yellow needles, soluble in sulphuric acid with a carmine-red colour; hydrochloric acid dissolves it, yielding a deep orange colouration, and from the solution the hydrochloride slowly crystallises in reddish-brown plates. It is very difficult to saponify this substance, alcoholic potash even at high temperatures being almost without action on it, and strong acids acting but slowly. When orthotoluylenediamine is oxidised in alkaline solution with α -naphthol, a blue substance belonging to the indophenol group is obtained; but with β -naphthol the reaction is quite different. A dark tarry precipitate is in the latter case obtained, which is extracted with dilute hot hydrochloric acid, leaving a red matter undissolved. On cooling the deep-yellow solution, the hydrochloride of the new base is obtained, liberated by ammonia and recrystallised from alcoholic glacial acetic acid, or toluene. The quinoxaline thus obtained is formed according to the equation—

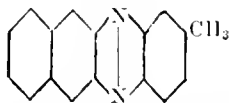


It forms pale straw-coloured needles, melting at 179.8° , and distilling at a higher temperature. Sulphuric acid dissolves it with a violet colouration; hydrochloric acid forms a yellow hydrochloride, nitric acid converts it into a characteristic nitro-compound. With fuming sulphuric acid a well-crystallised sulphonic acid is formed. There are theoretically possible two isomeric ortho-quinones derived from naphthalene, and consequently two corresponding isomeric naphthylenetoluin-

oxalines. That obtained by Hinsberg corresponds to the formula—



Therefore the new body must correspond to the other possible formula—



and is therefore to be described as β,β -naphthylenetoluquinocoline.—T. L. B.

α -Naphtholdisulphonic Acid and α -Naphthotrisulphonic Acid. A. Claus and P. Mieleke. Ber. 19, 1182—1187.

ACCORDING to Schultze, a mixture of the di- and trisulphonic acids of α -naphthol is formed when the latter is treated with fuming sulphuric acid. These are best separated by conversion into chlorides by treating the dried mixture of potassium salts with phosphorus pentachloride. α -Naphtholdisulphonic chloride is easily soluble in ether, whilst the chloride of the trisulphonic acid is only very slightly soluble, and the greater portion remains as a yellow horny mass.

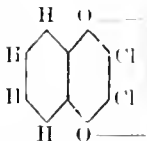
α -Naphtholdisulphonic chloride forms a bright reddish-brown syrup, which cannot in any way be made to crystallise.

α -Naphthotrisulphonic chloride forms, on recrystallisation from chloroform, small brilliant colourless crystalline plates, which are easily soluble in chloroform, benzene, and glacial acetic acid, sparingly so in ether and quite insoluble in alcohol. It does not melt without decomposition.

The position of the sulphonic-groups in the α -naphthol ring not having been satisfactorily determined, the authors have again investigated their position.

Tetrachloronaphthalene was obtained from the disulphonic chloride by treatment with 3mols. phosphorus pentachloride for some hours at 170–180° C. It forms colourless needles, melts at 82°, and is identical with Faust and Saane's tetrachloronaphthalene, prepared by decomposing α -chloronaphthalenetetrachloride with alcoholic potash.

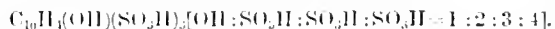
Tetrachloronaphthalene was prepared from α -naphthotrisulphonic acid, by treatment with phosphorus pentachloride at 210–220° C. in sealed tubes for 1½ hour, and then for 1 hour at 250° C. It forms colourless groups of needles, which melt at 140° C. To determine the constitution of this tetrachloronaphthalene it was oxidised to the quinone. This was obtained in yellow needles, and proved to be α -dichloro- α -naphthoquinone, with the constitution—



Chloroxynaphthoquinone was prepared from the quinone in the usual way. It forms beautiful yellow crystals, melting at 215°.

Dichloronaphthoquinoneanilide forms violet-red crystals, which melt at 203°.

From these derivatives there can be no doubt that the tetrachloronaphthalene has the constitution 1:2:3:4, and that α -naphthotrisulphonic acid is



On oxidising tetrachloronaphthalene, phthalic acid was obtained, and not the chlorinated acid, and the author concludes that the oxidation of naphthalene derivatives does not always take place in the same manner.

On heating α -naphthotrisulphonic acid with large excess of PCl_5 , perchloronaphthalene, C_{10}Cl_4 , is obtained, which crystallises in small colourless needles, melting at 202°.—G. H. M.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

Improvements relating to the Preparation of Animal Fibres for Felting. H. H. Lake, London. From John Thomas Waring, New York. Complete Specification. Eng. Pat. 4474, March 30, 1886. 4d.

IN order to increase the felting property of animal fibre, the inventor exposes the fibre to sulphurous acid gas in a suitable chamber. A special feature of the invention is the treatment of felt hat bodies, after being "formed," but prior to felting operations, with sulphurous acid.

—B. H.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

An Improved Method of Purifying and Decolouring the Water in which Silk and other Fibrous Materials have been Boiled, &c. E. Taylor, Rochdale. Eng. Pat. 6331, May 23, 1885. 8d.

THE waste liquor from silk dressing, or other analogous processes, containing soap and fat, is run into a vat and treated with gaseous chlorine, which precipitates the fatty matters.—C. C. H.

Improvements in the Manufacture of Blood Albumen. Thorsten Nordenfjelt, Westminster. Eng. Pat. 7462, June 18, 1885. 6d.

THE blood is first stirred or whisked to remove fibrine, and then carefully filtered. 100 to 1000gms. sugar dissolved in blood, and a similar quantity of a pure volatile oil (e.g., paraffin), are carefully mixed with 100kilo. blood. The sugar acts as a preservative, and the volatile oil makes the serum clear and almost colourless. The blood is slowly poured into a centrifugal machine, such as is now used for separating cream from milk. The serum is then concentrated, preferably *in vacuo*, and the final drying done in flat vessels, care being taken that the temperature never exceeds 45–50° C. By this process 80 per cent. of serum can be obtained yielding albumen of first quality only.—B. H.

VII.—ACIDS, ALKALIS, AND SALTS.

The Manufacture of Sulphuric Acid from Pyrites at New Moldova (South Hungary). Berg. u. Hüttem. Zeit. 45, 97.

THE nitric vapours are mixed with the sulphur gases in the flue leading from the kilns to the chambers. The works have no Glover tower, and therefore denitrate their nitrous vitriol by means of steam in drums lined with acid-proof bricks. The chamber acid is concentrated both in leaden pans and platinum still. Copper sulphate is prepared as follows:—Granulated copper containing from 0.3 to 0.5 per cent. of silver is treated in a large tank with sulphuric acid, of 25° B. at 60° C., and the copper solution thus obtained run into leaden pans. Here the silver settles out, and the warm liquor is allowed to crystallise in narrow wooden vessels. This crude salt is washed and refined by recrystallising. The

argentiferous deposit in the leaden pans, which contains from 3 to 4 per cent. of silver, is sold to silver refining works.—S. H.

Manufacture of Sulphocyanides. R. Gasch. Chem. Zeit. 10, 274.

THE sulphocyanides are daily finding increased application in the dyeing industry. A large source of sulphocyanides are the coke-ovens, from which ammonia and tar are condensed and utilised. It is well known that ammonium cyanide, formed in the gas manufacture, is the basis of the cyanogen compounds produced at the expense of the ammonia. Cyanide of ammonium is a readily volatile salt, and is carried forward along the pipes leading from the retorts of the gas-factory, together with sulphuretted hydrogen, decomposing partly with formation of sulphocyanide of ammonium, partly in presence of soluble ferrous salts into ferrocyanides. A portion remains undecomposed.

Thorough condensation prevents the formation, to any large extent, of sulphocyanides. As might be expected, the quantities of these substances contained in the ammoniacal-liquor vary considerably. The presence of these three compounds adds to the difficulty of producing pure sulphocyanide of ammonium by crystallisation. A further impediment in the manufacture was the working up of the weak liquors (1-3° B.) of the ammonia works, and the precipitation of these weak liquors by copper salt, as well as the difficulty of decomposing the insoluble copper sulphocyanide. The method has been simplified by using liquors of 8-11° B., as raw material, whereby the precipitation of the sulphocyanide with copper has become unnecessary, and by a simple operation a concentrated sulphocyanide liquor is obtained. The production from these sources has reduced the price of the salt to about £7 10s. per 100kiles.—J. B. C.

Danger of Fire through Nitric Acid. G. Lechartier. Compt. Rend. 102, 539-541.

THE author shows that when concentrated nitric acid (sp. gr. 1.5-1.51) acts upon organic substances—as, for instance, straw used for packing carboys—sufficient heat is produced to set them on fire.—D. B.

The Utilisation and Method of using Liquid Hydrocarbons as Carbonising and Neutralising Agents in the Alkali Processes, and for reducing Pyrites. B. H. Thwaite and J. Pedder, Trammere, Cheshire, and Widnes. Eng. Pat. 5514, May 5, 1885. 6d.

THE inventors claim the use of and methods of using mineral hydrocarbon for certain processes as above stated. An abstract is insufficient to make clear the aims of this patent. It will suffice to reproduce one proposition by the patentees:—"We may mix the mineral oil, soda ash (defined as Na_2SO_4), and calcic carbonate or quicklime together, and dissolve them in water at a temperature of say 200° F., and pass a powerful electric current through the solution, in order to displace wholly or partially the sulphur of the Na_2SO_4 by the carbon of the oil. The lime and sulphur combining to form an insoluble precipitate, we run off the supernatant solution and allow it to crystallise."—W. S.

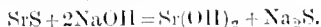
Improvements in the Production of Soluble Phosphates of the Alkalis in the Manufacture of Steel and Iron. T. Twynam, Middlesboro'. Eng. Pat. 6866, June 5, 1885. 6d.

THE inventor aims at the production of soluble alkaline phosphates from phosphatic slags produced in the manufacture of steel or iron, when an alkaline salt has been added in the converter for the purpose of eliminating the phosphorus during the conversion of the phosphatic pig into iron or steel. The phosphoric acid in these slags exists largely in a form insoluble in water, and in order to convert it into a soluble phosphate it is fused with an additional amount of an alkaline salt—the carbonate,

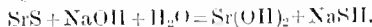
hydrate, or sulphate (the first is preferable)—in a basic lined open hearth furnace or cupola. The soluble alkaline phosphate thus formed can be dissolved out in water and obtained practically pure by evaporation and crystallisation, or the solution may be treated to form precipitated lime phosphate and an alkaline hydrate or carbonate.—S. H.

An Improved Process or Method of Producing Hydrate or Carbonate of Strontium or of Barium. E. F. Trachsel, London. Eng. Pat. 7136, June 11, 1885. 6d.

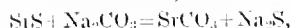
THE object of this invention is the conversion of strontium or barium sulphate into the hydrate or carbonate of these bases. The result is obtained by means of caustic soda or potash or sodium and potassium carbonate, which are used repeatedly and reconverted throughout the process. Strontium or barium sulphate mixed with coal are calcined in a reducing flame to convert the sulphate into sulphide. The latter is lixiviated with hot water, and the sulphide solution treated with an equivalent quantity of caustic alkali, whereby a deposit of strontium hydrate and a solution of an alkaline sulphide is obtained, as follows:—



Or by using half the amount of caustic alkali, thus—



The strontium hydrate crystallises out partly during the treatment and partly on cooling. The alkaline sulphide or sulphhydrate solution is easily converted into the carbonate by carbonic acid, and the carbonate is causticised by lime, and the hydrate solution thus obtained again applied to the decomposition of strontium sulphide. To obtain strontium carbonate the sulphide solution is treated with sodium carbonate, thus—



and the sodium sulphide solution is converted into carbonate as above described. In the case of barium the treatment and the reactions are analogous.—S. H.

An Improved Process of Producing Chlorine, and Chlorine and Ammonia. B. Mills. London. From Verein für Chem. Industrie, Mainz, Germany. Eng. Pat. 3322, March 9, 1886. 4d.

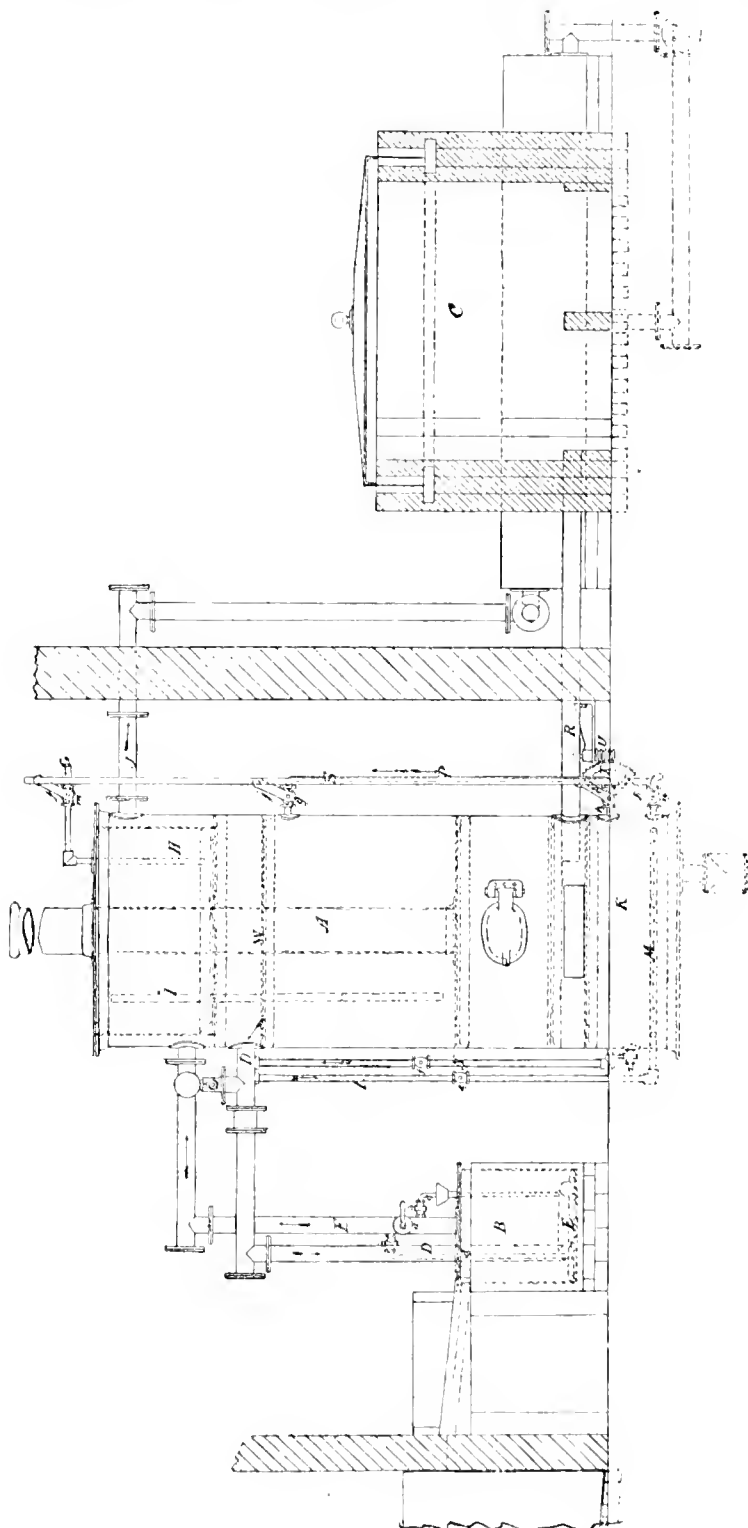
THE invention relates to the production, on the dry system, of chlorine, or of chlorine and ammonia, by passing vapours containing chlorine in combination over metallic oxides at a high temperature. Ammonium chloride vapours are passed over any oxidation grade of manganese at a temperature not reaching red heat. If protoxide of manganese be used, the reaction is shown by the equation— $\text{MnO} + 2\text{NH}_4\text{Cl} = \text{MnCl}_2 + 2\text{NH}_3 + \text{H}_2\text{O}$. If now air be passed over the resulting manganese chloride, manganese oxide and chlorine are obtained thus— $\text{MnCl}_2 + \text{O} = \text{MnO} + 2\text{Cl}$. In place of ammonium chloride vapours, gases containing hydrochloric acid may be passed over the manganese compounds with equal effect, thus—(1) $\text{MnO} + 2\text{HCl} = \text{MnCl}_2 + \text{H}_2\text{O}$; and (2) $\text{MnCl}_2 + \text{O} = \text{MnO} + \text{Cl}_2$. In the same manner oxygen combinations of other metals possessing several oxidation grades may be employed, as well as other volatile chlorine compounds.—S. H.

Improvements in Apparatus for Distilling Ammoniacal Liquor for the purpose of Producing Sulphate of Ammonia. A. Dempster, Elland, Yorkshire. Eng. Pat. 3220, March 8, 1886. 8d.

THE improvements in such apparatus relate (1) to heating the sulphuric acid in the saturator and the ammoniacal liquor in the feed tank by means of the noxious gases generated in the saturator; (2) to constructing the still with a decomposing chamber under the fire-box for getting off the fixed ammonia, the milk of lime in this chamber being agitated by ammoniacal gases instead of steam as is usual; (3) to providing the still with a

diaphragm in order to concentrate the ammoniacal gases ; (4) to drawing air along with the noxious gases through the purifier ; and (5) to employing a vertical rod

charged through a coiled lead pipe E, the noxious vapours being passed off by means of pipe F. But in order to heat the sulphuric acid they again return



for actuating several valves simultaneously. In the drawing the pipe D carries the ammonia gases given off in the still A to the saturator B, where they are dis-

through pipe C, which is immersed in the sulphuric acid, and ultimately pass out through *d* into F. The ammoniacal liquor is introduced into the liquor feed tank

H, which being narrower than the still A forms an annular space, which is heated by the waste gases from the pipe F. The decomposing chamber is shown at K, in which is placed the milk of lime, the ammoniacal gases passing down the pipe L, and after the fixed ammonia has been liberated the gases return through the pipe N. The still itself is divided by a perforated diaphragm plate W, so that as the gases arise and impinge against it, the steam is partially condensed, and consequently the strength of the ammoniacal vapours increased. The pipe J carries the noxious gases to the purifier C, which is connected with the furnace and flue of the chimney by the pipe R; the draught of the chimney draws the noxious gases along with atmospheric air through the oxide of iron deposited in the purifier, thereby continuously revivifying the oxide. Lastly, a vertical rod S is connected by levers *j* with the valves *m, g, h, n* and the toothed segment T, which is in gear with the worm U. By operating the latter the whole series of valves can be regulated simultaneously.

—S. H.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

An Improved Fire-resisting Cement. W. Montgomery, Newcastle-on-Tyne. Eng. Pat. 6025, May 16, 1885. 6d.

THIS cement is prepared in two parts—one as a powder, the other as a paste. The powder is composed of finely-ground porcelain or pottery waste (about 50 per cent.), finely-ground and long-kept Portland cement (about 40 per cent.), and ground red lead (about 10 per cent.). The paste is formed of very finely-ground porcelain or pottery waste, with about five per cent. of finely-ground plumbago; the water used in making this mixture into a paste contains a flux, such as borax, and a small proportion of silicate of soda. The proportions of the two parts are varied according to circumstances.—E. G. C.

Manufacture of Cement. W. Joy, Northfleet. Eng. Pat. 7189, June 12, 1885. 8d.

THIS invention relates to improvements in the manufacture of cement, consisting in means for ensuring the efficient distribution of the draught through the charge, in a cement kiln, loaded with layers of wet slurry and fuel, pipes or tubes, or bundles of faggots, or of sticks covered with readily-combustible materials, being so arranged as to form air-passages through the whole body of the charge. The cement kilns are built in two rows, back to back, and communicating at their upper parts with a flue between them and leading to a common chimney.—E. G. C.

Improvements in the Treatment of Stone in order to produce a Glazed Surface thereon. J. Matthew, Leeds. Eng. Pat. 8364, July 10, 1885. 6d.

TO produce a glazed surface upon certain classes of stones, rendering them impervious to moisture, the surface is first rubbed down smooth, a coating of any of the vitreous glazes well known to potters and glazed brick makers then applied, and the whole carefully fired in a kiln. The temperature of fusion of the glaze must be so low that the stone remains uninjured in the firing.

—C. C. H.

Improvements in the Manufacture of Artificial Stones and Concretes. A. C. Ponton, Viewfield Parkstone. Eng. Pat. 12,383, October 17, 1885. 6d.

THIS specification describes different methods of preparing artificial stone, the essential features of all of which are the combination of lime, either in solution or in a powdered state, with different varieties of silicates or siliceous materials. The materials are thoroughly incorporated or ground together with the addition of silicate of soda, or "powdered minerals or earthy matter of an inert character;" various salts of lime may be

added. The mixture is moulded into blocks, and dried by heat in ovens and hot sand baths, "to accelerate crystallisation." The prepared stone is stored in tanks containing lime water. Various other vitrifying materials are also described as useful.—C. C. H.

Improved System of Drying the Prepared Mixture of Raw Materials for the Manufacture of Portland Cement. C. Spackman, Leicestershire. Eng. Pat. 2659, February 24, 1886. 8d.

THE heated air, which has passed through the calcined cement, after the process of combustion in an intermittent kiln is completed, is utilised for the desiccation of a charge of raw material stacked in another kiln or kilns, ready for burning.—E. G. C.

X.—METALLURGY, Etc.

Action of Caustic Soda on Metals and Alloys. W. Venator. Chem. Zeit. 10, 319–321.

THE author has carried out the present series of investigations with the object of determining the nature of the action of caustic soda upon different qualities of iron, steel and other metals, and to what extent the action is due to impurities. Commercial caustic soda was used containing, as impurities, Na_2CO_3 1.85 per cent., NaCl 3.05 per cent., Na_2SO_4 .63 per cent., Fe_2O_3 and Al_2O_3 .11 per cent. A silver basin was used in which the metal and alkali were heated. No galvanic action occurred, and no atmospheric oxidation was found to influence the action when the metal was completely submerged in the alkali. The concentration of the alkali varied between 20 and 80 per cent. NaOH . The temperature was maintained just below boiling point of the lye. In other experiments the liquid was allowed to boil with inverted condenser. In other cases anhydrous soda was fused with the metal. The time of heating was generally 72 hours. The quantity of alkali was 2 kilos. The following are the metals tested:—Cast iron, wrought iron (two kinds), steel (two kinds), forged iron, brass, phosphor bronze, alloys of copper, tin, zinc and lead, lead and nickel. There was a strong action in the case of the different qualities of iron, steel and lead, whereas brass, phosphor bronze, nickel and the alloys of copper, tin, zinc and lead, and nickel were less attacked, and in some cases not at all. With copper scarcely any action could be detected. Phosphor bronze and nickel are little attacked. The action upon iron, steel, brass and lead were under similar conditions so different that no rule could be laid down. The action appears to depend upon the shape and surface of the metal; but more especially upon the structure and the kind of surface. Thus, for example, bright and rough-filed surfaces were more strongly attacked than when oxidised. Thin plates of steel were dissolved with evolution of hydrogen. Fine cast-iron borings were completely converted into ferric and ferrous oxide, the latter remaining in solution. The phosphoric acid also partly dissolves in the alkali, manganese is chiefly precipitated as oxide, carbon is to a great extent oxidised. All the qualities of iron evolved more or less hydrogen. With brass the action was almost entirely confined to the zinc and lead, so that a surface of copper remained. The intensity of the action depends on the percentage of the zinc in the alloy. Lead is oxidised, and dissolves in the alkali.—J. B. C.

On the Action of an Aqueous Solution of Carbonic Acid on Thomas-Slag. Chem. Zeit. 10, 531 and 584.

IF Thomas-slag in a very finely-powdered condition be treated with water containing carbonic acid, both phosphoric and silicic acids are readily dissolved. Reis experimented on a phosphatic slag which contained 16 per cent. phosphoric acid, and 8 per cent. silicic acid, and found that 6 litres of water, into which carbonic acid was passed, dissolved 5.8 per cent. phosphoric acid, and 3.5 per cent. silica. Meyer, independently from Reis, inves-

tigated the action of large amounts of carbonic acid water on a phosphatic slag, containing 22.2 per cent. phosphoric acid, and 54.0 per cent. lime. He treated 2 grms. of this slag with 8 litres of carbonic acid water, for 50 hours, and succeeded in dissolving 53.6 per cent. of the total phosphoric acid, and 57.8 per cent. of the total lime present. This result shows that carbonic acid does not act first on the caustic lime and afterwards on the calcium phosphate; but the action takes place simultaneously, and both constituents of the slag are dissolved in nearly equal proportions. This fact is very important in estimating the manurial value of powdered Thomas-slag.—S. H.

Improvements in Crucibles, Muffles, and other Refractory Apparatus. F. Maxwell Lyte, Putney. Eng. Pat. 4889, April 20, 1885. 6d.

MAGNESITE or other magnesium carbonate or oxide is calcined at a strong white heat, in order to ensure sufficient contraction, and thus prevent the subsequent cracking of the manufactured article. This operation should be repeated twice or thrice, the material being re-crushed and sieved after each roasting. The material is then mixed either with water alone, with a solution of a suitable magnesium salt (not sulphate), or with 6 to 10 per cent. of "heavy" magnesium hydroxide, or 10 to 15 per cent. of lightly-burnt magnesia and water, and fashioned into the required article, which may then be fired for use. The addition of sawdust or flour to the mixture increases the porosity; of powdered carbon, the refractoriness of the apparatus, which should be heated by astatki or gaseous fuel rather than by solid combustibles. When the finished apparatus is to be used in contact with fused metallic oxides, it should first be well glazed.—W. G. M.

Improvements in the Manufacture of Puddled Iron and Steel. Job Gilligan, Abertillery, Monmouthshire. Eng. Pat. 5140, April 25, 1885. 4d.

THROUGH holes in the side of a puddling furnace, a blast of air is allowed to act upon the molten metal until the latter begins to sink to the bed of the furnace, when the blast is shut off, and the metal balled in the usual way.—W. G. M.

Improvements in the Treatment of Pig Iron for Eliminating Impurities during the Process of its Conversion into Malleable Iron or Steel, also applicable for Analogous Purposes. Edward Fletcher, South Stockton-on-Tees, Yorkshire. Eng. Pat. 7802, June 26, 1885. 6d.

For a puddling furnace charge of 4½ cwt. of Cleveland pig, containing (say) 1.75 per cent. of phosphorus, a basic mixture of 4 lb. of lime, and 3 lb. each of soda and salt, is either mixed with the fettling of the furnace (which, however, it tends to break up), or preferably, therefore, with the flux of hammer scale, etc., introduced before the charge; or it is mixed with about 14 lb. of mill scale, and added to the melted metal, which then finally yields good merchantable bar.—W. G. M.

A New Bronze. J. P. Reitz, Bockenheim, Germany. Eng. Pat. 7880, June 29, 1885. 4d.

THIS is a bronze, resisting acids and alkalis. It is made by carefully fusing together 2.34 parts of tin, 1.82 parts of lead, and 1 part of antimony, and then adding them to 15 parts of melted copper.—W. G. M.

An Improved Process of Treating certain Descriptions of Auriferous and Argentiferous Material for the purpose of facilitating the Separation of the Metals contained therein. Elizabeth B. Parnell, Sydney, N.S.W. Eng. Pat. 3702, March 16, 1886. 4d.

THE (pyritous) ore is roasted at a temperature of 1100—1300° F., and then crushed and re-roasted at 1200—1600° F., when arsenic, antimony and some sulphur pass off with the gases, iron sulphide becomes peroxide, whilst the sulphides of silver, copper, manganese, nickel and

cobalt are sulphatised. These soluble sulphates are boiled with successive portions of water, until completely removed; the gold may then be extracted from the residue by amalgamation or chlorination, the valuable metals from the solution by precipitation. Additional oxygen, introduced in the roasting, shortens the time required for the operation.—W. G. M.

XI.—FATS OILS, AND SOAP MANUFACTURE.

The Manufacture of Mineral Lubricating Oils from Russian Petroleum Residues. Chem. Zeit. 10, 603—605, 618.

THE residues contain from 1 to 5 per cent. of water, and have a specific gravity of 0.905 to 0.912. To obtain from them light-coloured oils they must be carefully fractionated and refined, and as a high temperature of distillation would inevitably cause decomposition, the distillation must be assisted by means of superheated steam. The stills usually employed are represented in the drawings. They are made of wrought iron, and have a circular or elliptic cross-section. In starting an operation, the residues, which are previously warmed by a steam coil in a separate tank up to nearly 100° C., are run into the still, while the latter is very gradually heated up. The distillation in the beginning proceeds very turbulently owing to the presence of water, which cannot be removed completely by settling. At 130° C. to 140° C., a pretty regular ebullition sets in, and the distillate commences to come over at 150° C. to 160° C. At this stage superheated steam, free from any condensed water, is admitted (figs. 2 and 5 show the arrangement for superheating the steam), whereby the distillation is quickened. The first distillate stands at 0.840—0.860, and is used as an illuminating agent (*Helios oil*) in specially constructed lamps, it being too heavy for lamps of the usual construction. As soon as the distillate has the specific gravity of 0.870—0.880 it is separately collected and worked up for *light spindle oils*. A third fraction stands at 0.895—0.900, and is employed as *heavy spindle oil* and as a lubricating agent for gearing. The fourth fraction, specific gravity 0.908—0.912, is the largest in bulk, and is suitable for steam engines, whereas the last fraction, specific gravity 0.915—0.920, yields an excellent *cylinder oil*. This last fraction distils with great difficulty, and the fire must be carefully regulated to avoid decomposition. The pyrometer of the still shows the following temperatures for the different fractions:—I. 150—170° C.; II. 170—200° C.; III. 200—250° C.; IV. 250—300° C.; V. 300—320° C. The yield of the different oils is about as follows:—

I.	10—12.	.....	Colour, light yellow.
II.	12—15	.....	" yellow.
III.	8—10	.....	" yellow.
IV.	30—33	.....	" reddish-yellow.
V.	10—12	.....	" red.
Residue	12—15	.....

After separating the distillates from the condensed water in the usual manner, they are completely deprived of the still adhering water by heating them by means of a steam coil. After some time the water collects at the bottom and is drawn off. They are then refined with sulphuric acid of 66° B. in lead-lined conical vessels. The acid is added by degrees, while the mass is continually stirred either by an air current or a mechanical agitator. This treatment is continued for one or two hours. Light oils require from 5 to 7 per cent. of sulphuric acid, whereas up to 12 per cent. is wanted for heavy oils. The mixture of acid and oil is then allowed to rest until all the acid has separated, which is usually the case after the lapse of 20 hours. Then follows the neutralisation of the acid oil, which is indeed the most difficult and delicate operation of the whole process. This is due to the fact that the oils contain a certain amount of slimy matter, which is saponified by the addition of alkalis, thus forming an emulsion, which obstinately prevents the clarification of the oils. Experience has shown that it is best to run at first only a small portion of a very dilute caustic soda solution into

the acid oil, agitating briskly and adding after a while the rest of the alkali in very dilute solution. After some time a sample is taken, and when the emulsion

found necessary to pass a current of warm air through the oil for the complete removal of the water, the presence of which causes a turbidity of the oil. In

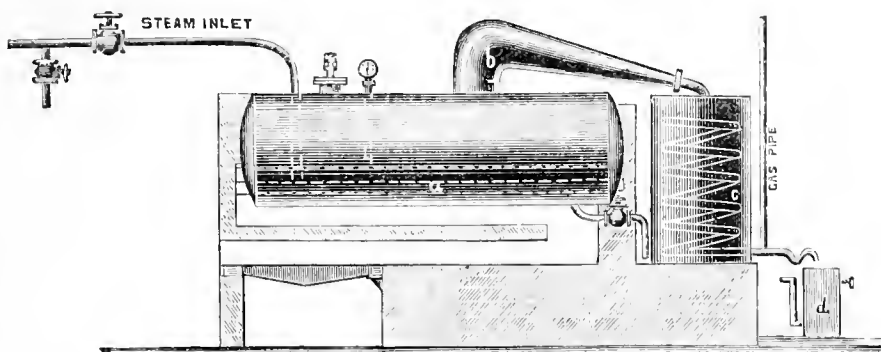


FIG. 1.

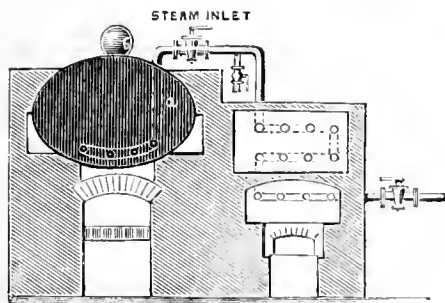


FIG. 2.

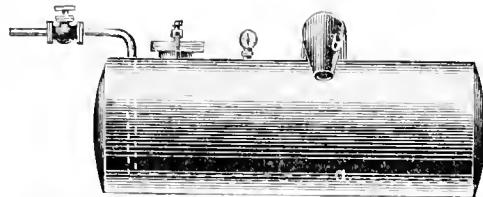


FIG. 3.

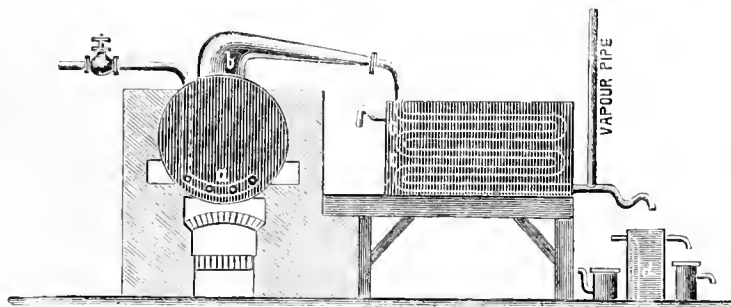


FIG. 4.

separates quickly from the oil, the agitation is discontinued and the mass allowed to rest. The bottom layer is drawn off and the oil washed, at first with cold water

conclusion, the properties of lubricating oils are discussed, and it is mentioned that the only trustworthy test for good quality is a determination of the viscosity. —S. H.

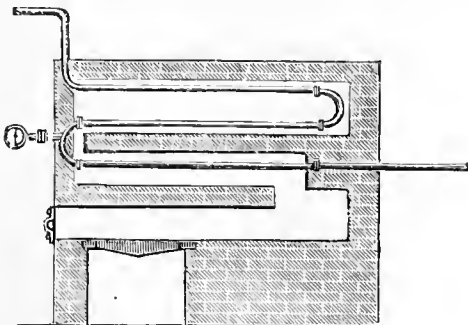


FIG. 5.

and afterwards with water of 65° C., until it has a neutral reaction with phenolphthalein. The water is then allowed to settle and removed. Sometimes it is

Improvements in the Manufacture of Oleaginous Compounds to be employed for Batching Wool and other Fibrous Substances, and for other purposes. M. G. Coltart and J. Menzies. Eng. Pat. 3725, March 23, 1885, 6d.

CRUDE or refined seal, whale, or fish oil is treated successively with strong sulphuric acid, water, and caustic soda solution, and is then mixed with four times its weight of refined mineral lubricating oil. Solutions of magnesium and barium chlorides are then agitated with the mixed oils, and the product is applied in the ordinary batching machines, or sprinkled by hand.—W. L. C.

An Improved Process and Apparatus for Treatment of Greasy Waste preparatory to Bleaching. T. J. Hutchinson. Eng. Pat. 6018, May 16, 1885. 8d.

VOLATILE solvents are used, but the special arrangement of kiers, condensers, retort, and reservoir is unintel-

ligible without the drawing. The waste is subjected to the action of the vapour of the solvent, which is volatilised in a separate vessel, and condenses in the kier. In addition to this general arrangement, the patentee claims two new forms of kier for holding the greasy waste; in the first the coils of steam-pipe for delivering steam to expel the solvent, form its inner walls, and in the second there is an inner perforated shell, lined with wire cloth, which is made to revolve by gearing, thus saving time in the action of the solvent.—W. L. C.

Improved Apparatus for subjecting Neutral Fatty Bodies to the action of Water at High Temperatures, and for the Direct Production thereby of Fatty Acids and Glycerine. C. D. Abel. Eng. Pat. 6562, May 29, 1885. 8d.

The object of the apparatus herein described, and illustrated by drawings, is to effect on an industrial scale the operation termed "aqueous saponification," by effecting an intimate molecular contact between the fatty body and the water. The difficulty of doing this has hitherto been that the agitation of the liquids had to be stopped as soon as the maximum useful pressure had been obtained, since it was necessary then to restrict the application of heat, which alone produced the motion. Two forms of apparatus are described—(1) for direct heating with fire; (2) for indirect heating, operating with steam from independent generators. In the latter there is an arrangement for fractional heating with steam by successive increments, for the purpose of producing this motion and molecular contact between the fatty matters and the water. The claim also includes the use of glycerine liquor as the refrigerating medium, whereby this is simultaneously reduced by evaporation to the required degree of concentration.—W. L. C.

An Improved Manufacture of Saponaceous Materials for Washing purposes. P. Brentini. Eng. Pat. 7454, June 18, 1885. 6d.

QUANTITATIVE directions are given for mixing a vegetable-oil soap with silicate of soda, resin, fucus seaweed or soapberry, and mirbane.—W. L. C.

Improvements in and Apparatus for Extracting or Separating Oil or Grease from Cotton Waste and similar Materials. J. Whittle. Eng. Pat. 1939, February 10, 1886. 8d.

THE patentee claims the use of the vapour of a volatile hydrocarbon, instead of the liquid form, for solvent purposes. The solvent is volatilised in a separate vessel, and its vapor is conducted into pans or chambers containing the cotton waste; these chambers are provided with perforated pipes, a heating coil or its equivalent, and improved clamping doors. Drawings are given.

—W. L. C.

Soap-dipping and Disinfectant Composition. J. G. Swan and R. M. W. Swan. Eng. Pat. 2780, February 26, 1886. 4d.

REDISTILLED crude carbolic acid, heavy tar oil, potassium oleate, glycerine, petroleum, and sulphur are compounded in a given order and proportions.—W. L. C.

XII.—PAINTS, VARNISHES, AND RESINS.

Improvements in Metallic Paints. Ferdinand Bosshardt, Manchester. From H. Graf, Hamburg. Eng. Pat. 6844, June 5, 1885. 6d.

THE inventor employs a powder or dust which is deposited in the condenser pipes or tubes leading from the retorts in which zinc is distilled. This powder is exceedingly fine, and when mixed with white lead, whiting, red ochre, black ochre, etc., yields paints possessing considerable body, and greater preservative qualities than other metallic paints of a similar character.

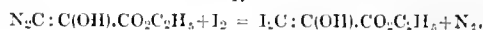
—E. G. C.

XIII.—TANNING, LEATHER, GLUE, AND SIZE.

On Gelatins. Eduard Buchner and Theodor Curtius. Ber. 19, 850—857.

By the action of alcoholic hydrochloric acid on gelatin, a solution is obtained which yields, with nitrite of soda, a uniform diazo-compound. Gelatin, soaked in water, is mixed with absolute alcohol, warmed on the water-bath, and during 20 hours hydrochloric acid gas is passed into the mixture. When entire solution is effected, and the alcohol and excess of acid have been removed, the syrupy mass is transformed by nitrite of soda into the diazo-compound, which is then extracted by ether, and finally purified by distillation with steam. This diazo-body is a lemon-yellow oil of peculiar odour, distilling at 140—142° under 717mm. pressure; it possesses all the characters of a diazo fatty acid, mineral acids eliminate the nitrogen entirely from it; boiling alkali gradually decomposes it, with formation of alcohol and carbonic acid. It reduces nitrate of silver in the cold. Reducing agents form first a hydrazine, but eventually resolve it into ammonia and a base of peculiar odour. It is attacked by cold ammonia solution, with loss of carbonic acid. With an ethereal solution of iodine, a volatile di-iodo-compound is formed, which is converted by strong ammonia into *di-iodoringylamine*, $\text{I}_2\text{C}:\text{CHNH}_2$, a light yellow prismatic crystalline substance, easily soluble in hot water and alcohol, sparingly soluble in cold water and in ether. At 170° it begins to turn yellow, gives off iodine at 175°, and melts at 192°, with complete decomposition. The analysis of the diazo-compound corresponds to the formula of the ether of *diazo-cxyacrylic acid*, $\text{N}_2\text{C}:\text{C}(\text{OH})\cdot\text{COOC}_2\text{H}_5$; and the formation of *di-iodoringylamine* would be expressed by the following equations:—

I.



II.



The product of the reaction of alcoholic hydrochloric acid on gelatin, forms, when treated with alkali, a volatile very unstable base of an intensely nauseous odour. Albumen, when submitted to the same treatment as the gelatin, gave in every respect similar compounds, thus showing the close relationship of the two substances.

—T. L. B.

A Process of Treating Tannic Extracts or Juices. J. C. Mewburn, London. From the firm of J. Marechal and L. Bories, of Paris. Eng. Pat. 10,147, August 27, 1885. 4d.

IN order to decolourise and purify tannic extracts or juices, carbonate of lead, in the proportion of about 2kilos. to 1000 litres of juice, is added. An amount of sulphate of lead, double the weight of the carbonate of lead used, is next added. The precipitate is then to be filtered off in any suitable manner.—B. H.

Improved Means or Process of Preparing Animal Gut for the Manufacture of Strings, Bands, and Belts therefrom. Frank Vornberger, Liverpool. Complete Specification. Eng. Pat. 3441, March 11, 1886. 4d.

THE inventor takes a gut of an "ox or beef animal" and a gut of a sheep, and, after cleansing them in the ordinary way, splits them into as many strands as may be desired. He then plunges them in a bath of pearl-ash water for four to six days, after which a convenient number of strands of each kind of gut are partially twisted together. The strands are then dipped in a bath of "Condy's fluid," and then hung up to dry. When dry they are "sulphured" in a wooden box for 24 hours, after which the twisting is completed. They are next plunged into a bath of isinglass and white-wine vinegar to stiffen them, and then dried. When dry they are smoothed with emery cloth, and finished off with gum arabic and oil.—B. H.

XIV.—AGRICULTURE, MANURES, Etc.

Oxidation of Sulphur in the Germination of Peas.
G. Tammann. Zeit. Physiol. Chem. 9, 416—419.

THE author extracted from yellow peas 0.359 per cent. of sulphuric anhydride, of which 0.075 per cent. was in the form of soluble sulphates, the remainder being present as sulphur. During the progress of germination the sulphuric acid was increased; after 25 days' growth in the dark the sulphuric acid amounted to 0.191 per cent., and in the light to 0.152 per cent. The phosphoric acid was similarly increased from 0.324 per cent. of phosphoric anhydride in the original seed to 0.443 per cent. after 12 days' growth. These results are contrary to the observations of O. Kellner.—D. B.

Occurrence of Allantoin, Asparagin, Hypoxanthin and Guadin in Plants. E. Schulze and E. Bosshard. Zeit. Physiol. Chem. 9, 420—444.

ASPARAGIN was found to be present in the leaf-buds of *Acer pseudoplatanus* and *Acer campestre*, *Betula alba*, *Fagus sileatica*, *Tilia parvifolia*, *Populus nigra* and *Vitis vinifera*. It was found also in the bark of the plane tree stripped from the younger branches in October and November, but was not contained in the bark of the oak, ash, and linden trees. According to Borodin, plants cultivated in water are rich in asparagin. He considers this substance to be a decomposition product of albumen, the products formed by the decomposition not, however, being reconverted into albumen owing to the lack of the necessary non-nitrogenous constituents. The authors incline to this view. They have examined grass, oat, and clover plants in the early stages of growth and found only a minute quantity of asparagin in one plant—viz., the red clover. The quantity was, however, considerably increased by keeping the plants for a week in a dark room with the cut end of the stem immersed in water. In this manner 900 grms. of oat plants gave 3.1 grms. of asparagin, and 800 grms. of red clover 1.7 grms. Allantoin was found in the plane tree and the leaf-buds of *Acer pseudoplatanus* and *Acer campestre*. It was contained also in the bark of *Esculus hippocastanum* and of *Acer pseudoplatanus* but could not be found in the leaf-buds or bark of the other trees referred to in the above. Etiolated lupin plants also contained no allantoin. The method adopted by the author consisted in precipitating the aqueous plant-extract with lead acetate, filtering and treating the solution with mercuric nitrate. This process has rendered possible the identification of hypoxanthin xanthin and guadin in lupins, in young potatoes (tubers), in beetroot, in the leaf-buds of maple and plane, in the bark of the plane tree, and in young grass, red clover, oats and vetches. In the course of their researches the authors isolated a new nitrogenous substance from the mercury precipitates obtained from the extracts of the red clover and vetch plants. It crystallises in silky needles which are sparingly soluble in cold, freely soluble in boiling water, and yields guanin when heated with hydrochloric acid.—D. B.

On the Carbohydrate, resembling Dextrin, from the Seeds of Lupinus Luteus. E. Steiger. Ber. 19, 827.

BAEYER and EICHORN (*Landw. Versuchsstationen*, 9, 168; 14, 164; 9, 275) have shown that a substance similar to dextrin may be extracted from the seeds of *Lupinus* by means of alcohol. The properties of this carbohydrate have now been examined by the author. He finds that it is not changed by yeast, and that boiling with nitric acid converts it into mucic acid. It is of importance to note that when heated with dilute sulphuric or hydrochloric acid, this body does not yield glucose, but a sugar which is identical with galactose (from milk sugar).—A. R.

Composition of the Wheat Germ, and the presence therein of a New Carbohydrate and of Allantoin. (Preliminary Notice.) C. Richardson and C. A. Crampton. Ber. 19, 1180—1.

THE authors have extracted from wheat germs an oil which they state is a very quick-drying one, and will

probably be of practical use. After removing the oil from the germs, a large quantity of sugars may be extracted with hot alcohol, as much as 15—18 per cent. of the germs being obtained. This consists of about 80—90 per cent. cane sugar, the remainder being a carbohydrate with high right-handed rotation, which does not reduce Fehling's solution before inversion, and is not fermentable, but is converted at once into a reducing sugar by the invertase of yeast. So far it has only been obtained in an amorphous form, and its properties do not agree with those of any known sugar. The admixture of this carbohydrate with the cane sugar caused the products of inversion of the mixture with acid to be right-handed, and the authors at first supposed it to be raffinose, but on examination no trace of the latter could be found; a great many experiments with the germs showed the constant presence of this right-handed, unfermentable sugar. The authors have also found allantoin in the germs; it amounts to less than half per cent. It was separated by means of mercury nitrate, it gave the characteristic crystals on recrystallisation, and corresponded in its composition and all its properties with allantoin obtained from animal sources. Until now allantoin has only been once found as a constituent of plants.—G. H. M.

Action of Ferrous Oxide upon Vegetation. O. Kellner, Landw. Vers. Stat. 1886, 32, 365

THE author's results confirm those of Griffiths—viz., ferrous sulphate is not directly injurious to vegetation; on the contrary, it has an action similar to that of gypsum and common salt in producing solution and disintegration of the nutritive constituents of the soil. Although soluble ferrous salts have no injurious action, their presence in the soil is due to a deficiency of oxygen in a soil containing humus, and accompany therefore acid humus. It is from the latter probably, or possibly from the deficiency of oxygen, that the healthy growth of the plant is retarded. The presence of ferrous salts is therefore an indication of the insufficient ventilation of the soil.—J. B. C.

Application of the Thomas-Slag. L. Blum. Chem. Zeit. 10, 339 and 340.

THE present paper is a critical review of Maltzan's process for working up the slag. The process consists in treating the finely-powdered slag with sulphurous acid gas and air. In this way, according to Maltzan's theory, the sulphurous acid in presence of air converts the quicklime into gypsum and oxidises metallic iron and ferrous and manganous compounds, and changes the sulphides into uninjurious oxides. According to the author's theory, based upon experiment, the Thomas-slag contains, in addition to ferrous oxide, several per cent. of ferric oxide. The sulphurous acid reduces the ferric oxide with the formation of H_2SO_4 and FeO . The sulphuric acid then combines with CaO to form $CaSO_4$. Or the reaction may occur in the following way—viz., calcium sulphite reacts upon Fe_2O_3 with the formation of $CaSO_4$ and FeO . When the whole of Fe_2O_3 is reduced, the formation of $CaSO_4$ stops. Sulphur in the slag is usually supposed to be combined with the calcium. By the action of SO_2 in presence of water, calcium hypsulphite is formed, and sulphur deposited. The author is of opinion that it is not possible to convert the whole of the quicklime into calcium sulphate by this method. By further treating the slag in the preparation of superphosphate, the acid liberates SO_2 . The quantity of acid used in neutralising the original amount of quicklime is only partly saved. The author further thinks that the slag prepared in this way for artificial manures must have an injurious effect upon vegetation, because the high percentage of calcium sulphite present has a very strong reducing action taking up the oxygen in the ground, even more than the sulphur and protoxide compounds. He suggests that the quicklime might be transformed into carbonate by the action of moist air on the powdered slag.—J. B. C.

XV.—SUGAR, GUMS, STARCHES, Etc.

Melitose or Raffinose from Molasses, Cotton-seed and Eucalyptus-manna. First Part. *Annalen*, **232**, 169—205.

I. INTRODUCTION, by B. Tollens (p. 169—172). II. Molasses and Cotton-seed, by P. Rischbiet and B. Tollens (p. 172—201). III. Melitose from eucalyptus-manna, by B. Tollens (p. 201—204). The results of the foregoing contributions have already appeared in *Ber.* **18**, 2611 (this *Journal*, 1886, 243). In addition, Tollens has carried out the intended experiments (*Ber.* **18**, 2616, footnote), and has found that eucalyptus-melitose is, like molasses-raffinose, completely fermentable; melitose and raffinose are also identical. IV. Quantitative Determination of the Amount of Raffinose in Mixtures, by R. Creydt and B. Tollens (p. 205; compare *loc. cit.* 2613, footnote).—G. H. M.

Existence of the war Constituents of Milk-sugar in Plants. A. Muntz. *Compt. Rend.* **102**, 624—627.

BOTH the products of the conversion of milk-sugar, galactose and glucose (from which the milk-sugar in animal organisms is probably built up), occur in plants, glucose as such, or as starch, cellulose, etc. The author now shows that the second inversion-product, galactose, is contained in many plants and plant-materials; he obtained it from gum arabic by treatment with dilute sulphuric acid, and also from all other gums, also from Iceland moss and similar substances, and from pectous bodies.—G. H. M.

Constituents of Milk-sugar in Plants. A. Muntz. *Compt. Rend.* **102**, 681—684.

THE author proves, in connection with the paper referred to in the preceding abstract, that the different substances from which galactose can be obtained, as the gums, pectous substances, etc., are very widely distributed in the vegetable kingdom, and are especially found in the edible plants—for instance, in the cereals, leguminous fruits, fruits, edible roots, bulbous plants, vegetables and cattle fodder.—G. H. M.

Analysis of the Products and By-products of the Sugar Industry. L. Harperath. *Chem. Zeit.* **10**, 271—272.

IT was formerly admitted that all sugars, with the exception of cane sugar, were eliminated by means of basic lead acetate. Since then it has been shown by Lippmann and Tollens that raffinose also remains behind. Recent researches have proved that by means of polarisation, before and after inversion, certain and exact determinations of the kind and quantity of these separate sugars may be made. The first object of this process is to aim at a method of sure and exact inversion. Many such methods have been proposed; but the majority are inexact. The methods were only used when the products of separation of the sugar from the molasses, and the molasses themselves, were to be analysed. Raffinose occurs, however, ready formed in the beets, and is separated to a great extent by the treatment of the syrup with lime. It occurs in large quantities in the pressed mash. It appears to diffuse less readily than cane sugar, as it is found in considerably larger quantities in the last cuttings; whereas, in the fresh unlixivated portions the proportion is smaller. Raffinose forms a more insoluble saccharate with lime, so that by thorough saturation and the lime process the larger portion is separated. This saccharate is decomposed by carbonic acid and other acids. When raffinose is present in small quantity, cane sugar crystallises, and the former remains in the syrup. In the analysis, raffinose has to be separated from cane sugar, and also from invert sugar. The inversion method is subject to considerable errors. Frühling and Schulz's method is the one usually adopted. 13.024 grms. (half normal) of the sugar are made up to 50cc., and the rotatory power determined. This gives total polarisation. A further 13.024 grms. are weighed out in

100cc. flask, and 50cc. water added. Then 5cc. of pure strong HCl are poured in, and the liquid warmed for 15 minutes to 67—70°. It is then cooled, neutralised with soda, and acidified with acetic acid. On reaching the temperature of the first solution, it is made up to 100cc., filtered, and the polarisation determined. The calculation is made from Clerget's formula. The author gives the following sources of error which may be introduced by this method:—For inversion a fresh quantity of sugar is weighed out, and the errors of weighing, moisture and mixing, are liable to be doubled. The inversion solution of half normal weight is polarised in 100cc. solution, but instead of 100 dextrorotation it gives only 44° levorotation after inversion. Every reading may produce a quadrupled error; an easy matter, seeing that no clearing with acetate of lead may be employed. Heated above 70°, other results are obtained; below 67°, even for a short period, has the same effect. A more protracted or limited heating than 15 minutes gives a different value. All these are minute but important details of the method. All sugar syrups contain lime, which with HCl forms CaCl_2 . This compound greatly influences the polarisation. Concentrated HCl carbonises sugar, and the dilute acid inverts it. As a matter of fact, the solution often becomes brown. On heating with acid longer than 15 minutes, grape sugar is decomposed with formation of humin substances. Fresh solutions of grape sugar have birotation, which they lose on boiling. By the present method boiling is not admitted, and therefore the birotation is not completely reduced. This reduction is further retarded by the presence of acids. The above is also true of dextrose. The main objection to the method is its want of reliability. There is little doubt, the author thinks, that the inversion does not yield comparable results. The following is the author's method:—52.096 grms. of sugar (twice the normal) are dissolved in a 200cc. flask, and the volume made up, 50cc. cleared with basic lead acetate, and made up to 55cc., then polarised, and the results obtained in percentages by adding a tenth. 100cc. are placed in a shallow porcelain basin of 100—130cc. cap., evaporated on the water-bath at 80—85° to 50cc., and then heated quickly to boiling over the flame with constant stirring, adding just before the solution boils, 5cc. of dilute H_2SO_4 (1 part concentrated H_2SO_4 to 2 parts water). The heating over the flame should not continue longer than 1 minute. The solution is poured back into the flask, and quickly made up to 100cc. with cold water, and cooled to 17½°. It is then filled exactly to the mark, with or without neutralising, filtered with or without charcoal, and the polarisation determined at the same temperature as the first solution. The solution remains limpid and colourless. If for the dextro-polarisation clearing with lead acetate were necessary, charcoal must be used for decolourising, whereby no influence on the left-handed polarisation could be detected. The quantities are calculated by Clerget's or Tuchschnidt's formula. At a temperature of 20° the two formulae are almost identical.

$$\text{Clerget's formula is } R = \frac{100 S}{144 - 0.5 T}.$$

S = total rotation, T = temperature.

$$\text{Tuchschnidt's formula is } R = \frac{100 S}{144.16035 - 0.5078 T}$$

$$\text{At } 20^\circ \text{ this becomes for the former—} \frac{100 S}{134}$$

$$\text{and for the latter } \frac{100 S}{134.01035}$$

—J. B. C.

XVI.—BREWING, WINES, SPIRITS, Etc.

The Influence of Different Processes upon the Composition of Wine. J. Moritz. *Chem. Zeit.* **10**, 322.

THE following modifications were introduced, and their influence upon the composition determined:—(1) The influence of separating the scum of the must before fermentation by heating; (2) the action of the quantity of

sugar in the must on the formation of glycerine: (3) the effect of concentrating the must by evaporation, on the quality and composition of the wine. Three experiments were made with a must of Austrian and Kleinberger grapes. It contained 11.2 per cent. sugar, and 1.36 per cent. tartaric acid. In the first experiment it was allowed to ferment in the usual way, in the second it was previously heated to 65°, and in the third to 95°. The best result was obtained in the case of No. 2. The analysis showed that it contained more glycerine and least tartaric acid. In order to determine the influence of the addition of sugar upon the quantity of glycerine, a series of samples of the same must were taken, and cane sugar added in different proportions. The experiments showed that with the addition of sugar the proportion of glycerine decreases. To what extent the proportions of the other constituents are modified remains undecided. Müller-Thurgau ascribes this result to the decrease in energy of the yeast. Every condition which retards its cultivation produces a corresponding decrease in the amount of glycerine. He considers that for 100 parts of fermentable sugar, the more glycerine is formed in proportion to the amount of albuminous substances at the disposal of the yeast cells. By concentrating the must the proportion of the acid and other constituents are increased. The former, as shown by Müller-Thurgau, retards the action of the yeast, and in consequence, also, the formation of glycerine. It was also shown by the above experiments that the increase in quantity of sugar determined a corresponding decrease in the quantity of alcohol.—J. B. C.

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

(A) CHEMISTRY OF FOODS.

Albumenoids of Cows' Milk. J. Sebelien. Zeits. f. Physiol. Chem. 9, 445–464.

ENGLING found that after the long-continued passage of carbonic anhydride through diluted whey from the colostrum, flocks separated out, which were soluble in 5 per cent. sodium chloride solution, and which he therefore considered to be *globulin*. Hammarsten stated that milk contained a globulin precipitated by magnesium sulphate. The author found that this *lactoglobulin* showed a great agreement with the *paraglobulin* of blood. For its preparation the milk is first precipitated with sodium chloride (after addition of sodium hydrate if the milk has an acid reaction), warmed at 35° (whereby an albuminous substance and calcium phosphate is precipitated), the filtered liquid saturated with magnesium sulphate; the precipitate thus obtained was dissolved in water and again precipitated with magnesium sulphate. The globulin thus prepared is not precipitated from its solution by dialysis; a cloudiness is caused, which forms a precipitate only after addition of acetic acid. A solution with 5 to 10 per cent. sodium chloride clouds at about 72°, and coagulates at 75–76°. This cannot be casein, since both pure casein and also a mixture of this with blood serum give no permanent precipitate on heating with 5 to 10 per cent. salt. The albumen of milk has not yet been obtained in a pure state; it is stated that it is identical with serum-albumen. The author prepared lact-albumen according to the method used by Hammarsten for serum-albumen. Pure lact-albumen is not precipitated by magnesium sulphate at 40°, but by sodium sulphate at 30°, and by ammonium sulphate at ordinary temperature. A trace of acetic acid does not precipitate a hydrochloric acid solution. A two to three per cent. solution of lact-albumen, free from salts, coagulates at 72°, and at higher temperatures when sodium chloride is present. In this respect it agrees with the serum-albumen prepared by Starke. Lact-albumen has a rotary power $\alpha_D = -36.4$ – -36.9 , whilst serum-albumen is given about -60 – -62° by different observers. A preparation boiled with alcohol and which gave 1.13–2.6 per cent. ash, yielded the following numbers on analysis:

carbon 52.19; hydrogen 7.18; nitrogen 15.77; sulphur 1.73–1.96 per cent. The low carbon and high sulphur percentages distinguish lact-albumen from casein.

—G. H. M.

(B) SANITARY CHEMISTRY.

Improvements in the Treatment of Excreta and House Sewage, and an Improved Manufacture of Material and Apparatus therefor. J. Hewes, Leicester. Eng. Pat. 5153, April 25, 1885. 8d.

THE excreta is submitted to destructive distillation in cast-iron retorts or pipes, closed at each end by valves, set in a furnace. The products of distillation are led by a pipe from the tops of the retorts into the lower part of the furnace and consumed. The resulting product may be used either to prevent incrustation in steam boilers, or as a defecator for sewage, alone, or in conjunction with sulphuric and hydrochloric acids, bichromate of potash, sulphate of soda, picric acid, or an acid extract of end-bear, indigo, or logwood.—C. C. H.

Improvements in the Means and Apparatus for the Separating of Solids and Semi-solids from Sewage and other Liquids. P. Smith, Manchester. Eng. Pat. 7714, June 25, 1885. 8d.

THE apparatus consists of a cast-iron cylinder revolving horizontally in a rectangular closed box; the underside is in contact with an endless band of cloth pressed up thereto by pressure rollers. The endless band is kept in tension by adjustable rollers, one of which is driven by a belt, causing it to travel and rotate the large cylinder first mentioned. The liquid or sewage is admitted between the cloth and the cylinder by a valve at the upper part of the periphery; the liquid portions are expressed by the pressure rollers, the solid adheres to the surface of the cloth, and is removed by a scraper at a point later in the path of the endless band of cloth. The action of the machine is therefore continuous.

—C. C. H.

Improvements in the Treatment of Sewage. J. M. H. Munro, Salisbury, S. H. Johnson and C. C. Hutchinson, London. Eng. Pat. 7759, June 25, 1885. 6d.

SLAG, from the basic process of steel-making, known as "basic cinder," is treated with an excess of sulphuric acid of 1500 sp. gr. This produces a mixture of soluble phosphate of lime, calcium, ferrous, ferric, and magnesium sulphates, etc. An excess of the acid prevents the precipitation of ferric phosphate from a solution of the above "soluble cinder." The sewage is first treated with excess of lime above that required to render it neutral. A solution of the "soluble cinder" is then added, sufficient in quantity to precipitate the colloid matter in solution in the sewage; the excess of lime first added serves to precipitate the phosphoric acid both in the sewage and the "soluble cinder," and this, together with the soluble and insoluble nitrogenous matter also thrown down, produces a rich sludge. The sludge is then treated with about 0.75 per cent. of lime, and afterwards with about 5 per cent. of the "soluble cinder"; this facilitates the subsequent operation of filter-pressing and produces a rich fertiliser. The patentees claim (1) the treatment of sewage with lime and "soluble cinder" as described; (2) the treatment of the sludge as described, or the use of superphosphate of lime in place of the "soluble cinder."—C. C. H.

Improvements in the Treatment of Sewage at or near the Outfall. J. B. Spence, London. Eng. Pat. 8912, July 23, 1885. 4d.

THE sewage is deodorised by the passage of sulphurous anhydride into the sewer at or near the outfall.—C. C. H.

A Disinfectant Tablet for use in Flushing Closets, Stables, Drains, and for other similar Purposes. W. H. Symons, London. Eng. Pat. 8351, July 10, 1885. 4d.

ANY disinfectant or deodorant, preferably permanganate of potassium, is mixed with some binding material—*e.g.*, calcium sulphate, alumina, silica, or lime; the mixture is formed into tablets and suspended in cisterns, drains, etc., where it slowly dissolves.—C. C. H.

Improvements in Filters or Water Purifiers. F. Gresvener, Glasgow. Eng. Pat. 2182, February 15, 1886. 6d.

Two layers of animal charcoal, one fine and the other coarse, separated from each other by a porous diaphragm, are inclosed between two discs of porcelain, the lower of which is fixed, the whole being placed in an earthenware container. The two discs are fitted with compressed carbon plugs. By this combination of parts, the filtering medium can be readily renewed.—C. C. H.

Improvements in Antiseptics and Disinfectants, and in the Manufacture of the same. A. L. Dussek, London. Eng. Pat. 4117, March 24, 1886. 4d.

VEGETABLE TAR is distilled and the acids, spirits, and oils separated. The acids are further separated from the spirits and oils and the latter are mixed with an equal quantity of turpentine; one third of this is distilled off, and to the remainder is added one part of rosin or gum-arabic. The solution when cold is heated with caustic soda. The extract so prepared is called "Sano." This may be mixed with chalk, lime, or baryta, and reduced to a powder, which is a strong disinfectant.—C. C. H.

Improvements in Water Softening Processes. P. A. Maignen, London. Eng. Pat. 7446, June 18, 1886. 6d.

THE precipitate produced in the softening of water, consisting mainly of carbonate of lime, is rendered caustic by ignition and used for softening a further quantity of water either alone or in conjunction with silicate of soda, manganese dioxide saturated with sulphuric acid, or sulphate of manganese.—C. C. H.

(C) DISINFECTANTS.

Apparatus for Disinfecting, Deodorising, or Precipitating Purposes. F. J. Austiu, London. Eng. Pat. 4981, April 22, 1885. 4d.

ANY disinfecting material is placed in the interior of a closed porous vessel, a portion only of the exterior of which is glazed; this is placed in another vessel. Moisture from the outside passes through the porous envelope and liquifies the disinfectant, which, "on the principle of the natural law of Osmosis," passes through the shell of the vessel. The apparatus may be used for disinfecting air or water.—C. C. H.

XVIII.—ELECTRO-CHEMISTRY.

Improvements in Electric Batteries. J. B. Neyraud, Lyons, France. Eng. Pat. 6964, June 8, 1885. 6d.

IN order to prevent water saturated with a salt at the bottom of a porous cell of an electric battery rising to the upper part of it, and the head or screw from becoming oxidised, a battery is constructed with a porous pot having a porcelain or earthenware cover glazed at the upper part. This cover is provided with a nipple having a conical hole also glazed; the hole is stopped by a lead plug, in which is fixed a screw-threaded rod provided with a nut serving as a connection. The lead plug is traversed by a platinum wire, which also passes through a suitable insulating material sealing the plug; the wire is connected to a piece of carbon placed in the interior of the porous pot, and surrounded by small pieces of similar material; the bottom of the porous pot is formed of insulating material.—W. B.

Improvements in Chemical Precipitation, and in the Separation of Matter mechanically suspended in Liquids. J. G. Lorrain, Southampton Row, London. Eng. Pat. 7126, June 11, 1885. 6d.

THIS patent has for its object the facilitating or hastening of chemical precipitation or separation of matter mechanically suspended in liquids, by passing through the liquid in which the formation of a precipitate is taking place, or in which matter is already mechanically suspended, electricity of the kind known as "statical electricity."—W. B.

Improvements in Voltaic Batteries. H. J. Harris, Bristol. Eng. Pat. 8228, July 7, 1885. 8d.

THE author claims the use of porous cells having a flange or foot, by means of which they can be secured to the bottom of the outer cell by pouring in a layer of paraffin so as to cover the flange or foot; also the use of a hollow cover bearing an arrangement of hinged contact plates, by means of which batteries of several cells may be coupled up in a variety of different ways. Outlets through the cover are provided for the escape of the gas from the porous cell only.—W. B.

Improvements in Voltaic Batteries. F. H. W. Higgins, London. Eng. Pat. 8540, July 14, 1885. 8d.

THE negative plates of a voltaic battery are formed with a series of perforations which taper, and are larger on the inner face of the plate than on the outer, the partitions between the perforations being reduced to a knife edge on the inner face of the plate. The perforations are filled with oxide of lead paste. Two plates are fixed with their inner faces together, and on account of the tapering form of the perforations the composition cannot escape from them. The plates are then further prepared by exposing them to the current of a battery or dynamo-electric machine. The liquid made use of is such that the lead does not pass into solution.—W. B.

A New or Improved Method of Metallising Woven Textile Fabrics, especially Flannels, in order to develop Electricity for Hygienic and Medicinal purposes. U. R. Pumariega Aviléz, Spain. Eng. Pat. 2322, February 17, 1886. 4d.

WOVEN materials, especially flannels, are steeped in a bath composed of equal parts by weight of oxides of iron, copper, zinc, and tin mixed in the form of an impalpable powder in a solution of three parts of gum to 100 parts water, and afterwards dried. When woven materials thus prepared are applied to the human body, a weak but constant electric current is generated by means of the perspiration so long as the materials remain in contact with the body.—W. B.

Improvements in Galvanic Batteries. J. Scerson, Boston, U.S.A. Eng. Pat. 3726, March 16, 1886. 8d.

THIS patent relates to the construction of an improved bichromate battery having a porous cell supported on legs and containing an inner chamber perforated at the bottom, whereby the solution surrounding the porous cell is given free access to the lowest portion of the element contained in the inner chamber.—W. B.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Acetophenone or Hyponone: a New Hypnotic Body. S. Simonsin. Pharm. J. 3, 582.

ACETOPHENONE proves to be an effective hypnotic, according to observations made by Dujardin-Beaumez.—A. R.

Official Quinine Bark. G. Vulpius. Chem. Zeit. 10, 273—274.

THE new German pharmacopoeia demands a minimum of 3.5 per cent. of alkaloids in all quinine barks, from

any source, whereas according to the old regulation a minimum of two per cent. was authorised. This alteration is due to the fact that it had become customary to deliver to the druggist as quinine barks varieties too poor to be extracted for quinine, and that the Indian barks are much richer than those formerly used. The pharmacopœia also adds a method for determining the total alkaloids. This method does not distinguish between the different alkaloids, the result being that the barks poor in quinine are thrown on the hands of the druggist. Thus, for example, quinine bark during one season sold at prices varying from eight shillings to less than three. The latter quality contained 6.6 per cent. total alkaloids, consisting of 1.22 per cent. quinine, 2.80 per cent. cinchonidine, and 2.58 per cent. cinchonine and amorphous bases. The method, in short, given in the pharmacopœia is quite insufficient to protect the interests of the druggist. The author substitutes the following:—The total alkaloids are first estimated by the above-mentioned method, 20grms. powdered bark are macerated with 10grms. of 10 per cent. ammonia, 20grms. of spirits of wine (90 per cent.) and 170grms. of ether for 24 hours, 120grms. of the clear solution acidified with HCl, and freed from spirits of wine by heating. The alkaloids are precipitated in the filtered liquid, made alkaline with caustic potash, dried, and weighed. The total alkaloids thus obtained are shaken with ten times the weight of ether, which is then filtered into a weighed flask, the residue well washed, and the ether expelled. The flask then contains quinine together with inconsiderable quantities of quinidine and amorphous bases. To obtain more exact results, the residue in the flask is dissolved in spirits of wine, the alkaloids in this solution by exact neutralisation converted into sulphates with sulphuric acid and quinine precipitated in the usual way as berapathite, the correction being taken into account. The author recommends as an addition to the present German pharmacopœia the fixing of a minimum of quinine for official barks.—J. B. C.

Manufacture of Chloroform. Chem. Zeit. 10, 338—339.

If fresh bleaching powder be mixed with alcohol and water into a thick mass, a violent reaction occurs, with the formation of chloroform, formic acid, ethylhypochlorous ether, and small quantities of other compounds. In

The Generator.—For this purpose cylinders of boiler-plate, 13–14mm. thick, are used. For a daily production of 125kilos. of chloroform, four generators, 1.4m. high and 2m. diameter, are required. In each generator is an agitator, an inlet tube for steam and one for water, and a manhole for charging with bleaching powder. On the upper edge of the generator is a perforated leaden

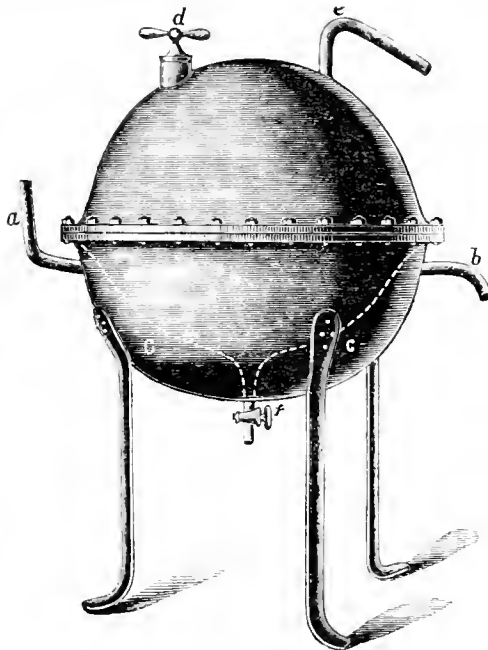


FIG. 2.

pipe in connection with the water-main: a tube, 75mm. inside diameter, with the greatest possible dip, combines the generator with the condenser. The latter is placed as near as possible to the generator. On leaving the condenser, the condensing worm ends in a receiver. This is a small cylinder, 75cm. high and 40cm. diameter, of boiler-plate of 15mm. thick.

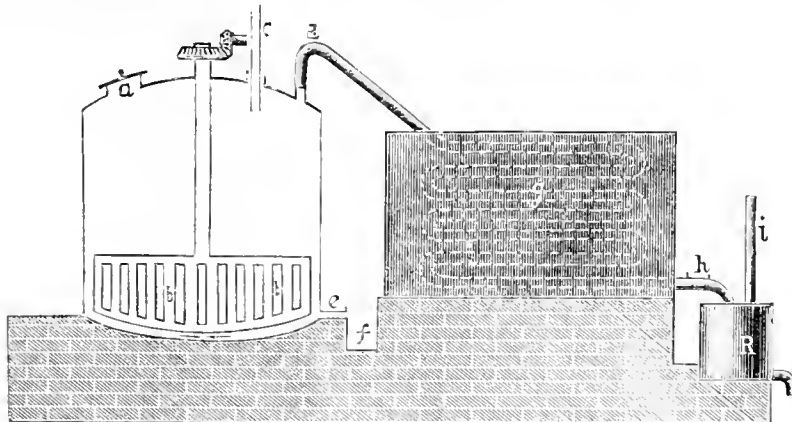


FIG. 1.

this reaction chloride of calcium is unacted upon. Calcium hydrate only takes part in the action in so far as it saturates a portion of the products formed by an excess of the bleaching powder in its action on the alcohol. In order to prevent the formation of these secondary products, an excess of alcohol must be present. The necessary apparatus for the preparation of chloroform is exceedingly simple. It consists of one or more generators, condensers, small iron receivers, store tanks, washing pans, and a copper rectifying retort.

Washing Pans.—Crude chloroform contains considerable quantities of alcohol in solution, from which it is separated by washing with water. The apparatus consists of a narrow, high cylinder, with a hemispherical bottom, and an agitator in the form of a ship's screw, so that the liquid is worked upwards. At the side of the apparatus taps are attached to let off the wash-water. As this water contains alcohol, it is kept in a store-tank. In order to wash a daily yield of 160–175kilos. of crude chloroform, 800 litres of water are necessary.

Rectification.—The chloroform, separated as far as possible from water, is rectified in a copper retort, as shown in Fig. 2, the construction of which may be readily understood from the drawing. It is desirable, in this case, to connect the retort and the condenser with a tube, as short and as sharply inclined as possible. Experience has shown that with 4 parts of bleaching powder of 103–108°, 3 parts alcohol of 96° Tralles, and 13 parts of water, give the best yield. In order to reach a daily production of 125kilos chloroform, each generator must be charged with 400kilos. bleaching powder, 300kilos. alcohol, and 1300 litres water. The alcohol is first run in, then water, until 1600 litres of liquid are in the vessel, and the agitator is set in motion. The 400kilos. bleaching powder are then added: the vessel is closed and heated with steam. At a certain point of the generator an iron tube dips into the liquid, which tube is filled with oil, and in the oil a thermometer is placed. As soon as the thermometer indicates 40°, steam is turned off; the agitator is kept in motion until the thermometer indicates 45°, and it is then stopped. The temperature now rises slowly to about 60°, usually its highest point. In very warm weather the temperature is apt to rise higher; but this must be as far as possible prevented by running cold water over the apparatus. Between the receiver and the condenser a glass tube is inserted. As soon as the reaction begins a fine rain of chloroform, alcohol, and water is seen to be driven through the tube. The air driven from the apparatus is saturated with chloroform vapour, and this must be allowed to escape into the open air, after previously being washed through water. This violent reaction lasts about a minute and then chloroform begins to run over. As soon as about 3kilos are distilled off, the agitator is again set in motion. When no more chloroform separates out in a sample of the distillate, the iron receivers are changed, and the distillate, consisting of alcohol saturated with chloroform, is collected separately. This is continued till, on shaking with water, no more chloroform separates out. The distillation is continued, and the weak alcohol run into the store-tank until it reaches 3 per cent. Tralles. The lime-mud is then run off. The weak alcohol in the tank is made up to the proper strength and used for a fresh operation.

—J. B. C.

The Action of Papaine. C. Finkler. Chem. Zeit. 10, 357–358.

LIKE many other plants, *carica papaya* contains a ferment which dissolves albumen. From its chemical nature it may be considered as belonging to the group of peptones. Under the name of *Papaine Finkler* two preparations are used in commerce (this Journal, 1885, 571). Experiments have shown that these preparations are ferments which dissolve albumen; that this solvent action occurs under very different conditions; that it is possible with a very small quantity of the ferment to dissolve a large quantity of albumen. The action is not one of simple solution, but the albumen is changed into peptone. Papaine dissolves albumen best in water, almost equally well in a slightly alkaline solution, but less readily in dilute HCl. Experiments were made in these three directions with 30grms. fresh fibrin, 0.32gm. papaine and 100cc. water, 100cc. 0.1 per cent. HCl, or 50cc. 0.1 per cent. KOH. After 72 hours the fibrin in all cases was completely dissolved. This action goes on between wide ranges of temperature. A higher temperature, 40–50°, has an accelerating influence. The author finds from experiment that 1 part of *Papaine Finkler* dissolves 1000 parts of fibrin. It has been repeatedly observed that 8grms. hard boiled albumen were dissolved by 0.01gm., and even by 0.001gm. papaine. Other papaine preparations were tested in the above manner, especially *Papaine Christy* from London, and that of Merck in Darmstadt.—J. B. C.

Remarks on some New Drugs. Chem. Zeit. 10, 618.

Carapa guayanensis Aubl.—The plant is one of the highest trees in Guiana; the fruit has a nearly spherical shape, and contains from 7 to 8 seeds, the skin of which is

spongy, and of a reddish colour. A colourless buttery oil is obtained from the seed, chiefly consisting of palmitin. Experiments are now in progress with a view to using it as an antidote against diseases of the skin. Formerly it was exported to Europe as a raw material in the manufacture of soap. The oil of the West African *Carapa quincensis* Swart. possesses similar properties. The bark of this tree contains an alkaloid, to which the name of touloucoune has been given. Both drugs resemble the azadirachta bark in their action on the human body, and will probably prove effective against intermittent fever and nervous debility.

Anchietia salutaris St. Hil.—The root of this plant is recommended as a remedy for syphilis, and, in form of a syrup, as a cure for quinsy. The syrup is prepared by mixing four parts of a tincture obtained from the root with thirty parts of syrup simplex. The powdered bark of the root is a powerful purgative, probably owing to the alkaloid present—*anchietine*. The plant grows as a bushy shrub in the neighbourhood of Rio de Janeiro.

—S. H.

Some Constituents of the Rind of the Bitter Orange. Tanret. Comp. Rend. 102, 518–520.

THE extract obtained with alcohol of 60° was evaporated, the residue agitated with chloroform, the chloroform layer (A) distilled and the residue therefore treated with cold alcohol, a crystalline powder (a) and a resin (b) being obtained. The aqueous layer (above the chloroform layer A) deposits yellowish crystals (c), and the mother-liquor, on treatment with lead acetate and saturation with sodium sulphate, gives two other constituents, a yellow product (d) soluble in alcohol, and a white powder (e) insoluble in alcohol. The substance (a) is tasteless, and insoluble in water and ether, but dissolves in 100 parts of hot alcohol and 60 parts of chloroform; it is soluble also in alkalis, but not in ammonia, has the composition $C_{25}H_{34}O_7$, and forms a calcium salt of the composition $(C_{25}H_{32}O_7)_2Ca$. Yield = 0.5 per 1000. The product (b) softens at 12°, has a very bitter taste, dissolves freely in hot water, ether, chloroform and alcohol, exhibits a rotatory power $[\alpha]_D = -28^\circ$, closely resembles hesperidin in its reactions, and has the composition $C = 61.14$, $H = 6.57$. Yield 1.0 per 1000. The substance (c) is called *isohesperidin* $C_{27}H_{36}O_{12}$, is distinguished from hesperidin by its solubility and has a rotatory power $[\alpha]_D = -89^\circ$. Yield from 4 to 30 per 1000. The substance (d) is a glucoside, *aurantiamarin*, soluble in water and alcohol, insoluble in ether and chloroform, the bitter taste of the rind being due to this substance. It has a rotatory power $[\alpha]_D = -60^\circ$, contains $C = 53.04$ – 53.48 , $H = 6.36$ – 6.16 , and forms the natural solvent for hesperidin (five parts of this substance suspended in twenty parts of water dissolve one part of hesperidin). Yield 15–25 per 1000. (e) is *hesperidin*. Yield 0.0 to 0.6 per 1000.—I. B.

Crystallised Aconitine. C. F. Bender. Pharm. Centralt. 26, 433.

THE preparation of pure aconitine is as follows: First extract with ninety per cent. alcohol, filter the extract through cloth, distil off the alcohol, separate the alcoholic residue from resin and fats, dilute with water, filter, add pure bicarbonate of soda, agitate with ether, pour into dilute acid, digest the alkaloid solution with animal charcoal, filter, separate the base, extract with ether, and prepare the salt of the hydrobromide. After recrystallising the hydrobromide, the base is precipitated with magnesia and taken up with ether. On distilling off the ether aconitine remains in snow-white crystals.—J. B. C.

Brucine. A. Hanssen. Ber. 19, 520–524.

THE author has prepared *mononitro-brucine* by acting upon the methyl iodide compound in alcoholic solution with nitric acid. The resulting solution, filtered from resinous products, gave yellow crystals. These crystals contained no iodine, and further investigation showed

that the methyl group had been eliminated and that the nitrate of a mononitro derivative had been formed. On addition of sodium carbonate solution, the nitro-base separates in the form of needles. This product was recrystallised from water. When heated on platinum it explodes. The formula given by the author is $C_{23}H_{25}N_2O_4.NO_2$. This nitro-compound was reduced with tin and hydrochloric acid and gave the hydrochloride of an amido-base, which was recrystallised from water and possessed the formula $C_{23}H_{25}N_2O_4.NH_2.3HCl$. The following are the reactions for *amido-brucine*: Fe_2Cl_6 produces first a green and ultimately a brown colouration. A very dilute solution of potassium bichromate produces a blue-violet colouration, which is very fugitive. Amido-brucine dissolves in concentrated nitric acid with a yellow colour, which becomes red with $SnCl_2$. The first two reactions correspond to those of amido-strychnine. The author intends to investigate the action of bromine upon this compound.—J. B. C.

On Morphine. O. Fischer and E. von Gerichten. Ber. 19, 792—795.

IN order to determine the constitution of morphine, various attempts have been made to convert it into bodies free from nitrogen. In connection with Hesse's observations on this subject (*Annalen*, 222, 223), the authors have obtained from morphine methiodide, a substance the formula of which, $C_{14}H_{19}O_2$, is that of a dioxypheanthrene, and its general properties are very similar to, though not identical with, Graebe's pheanthrenehydroquinone. From codeine methiodide a substance of the formula $C_{17}H_{21}O_2$ is obtained.—A. R.

XXII.—GENERAL ANALYTICAL CHEMISTRY.

Filtering Apparatus. Otto. N. Witt. Ber. 19, 918—919.

PERFORATED glass or porcelain plates, about 40mm. in diameter and 4 to 5mm. thick, are made with sloping edges so that they fit closely into a glass funnel; upon the plate two round strong filter papers are placed to form a paper sieve, upon which the substance to be filtered is poured. By connecting the apparatus with an air-pump, the filtration takes place very rapidly, the substances remaining on the filter can be washed thoroughly, and pressed into hard cakes with a spatula. The cakes can then be removed by turning the funnel over and tapping the sides gently or by blowing into it.—T. L. B.

Zinc Dust Reactions. H. Schwarz. Ber. 19, 1140.

THE author describes two simple methods for preparing pure hydrogen gas and carbonic oxide. On heating a mixture of zinc dust and calcium hydrate gradually in a combustion tube, a constant current of pure hydrogen is liberated according to the equation: $Zn + CaH_2O_2 = ZnO + CaO + H_2$. On mixing the zinc dust with calcium carbonate in molecular proportions and heating as before, pure carbonic oxide gas is evolved thus: $Zn + CaCO_3 = ZnO + CaO + CO$. In both cases nearly theoretical quantities of gas are obtained. The author intends to apply this reaction to organic hydroxyl or carboxyl compounds.—D. B.

Determination of the Value of Chloride of Lime by means of Peroxide of Hydrogen. G. Lange. Ber. 19, 868—871.

THE principle of the process lies in the fact that hypochlorites when mixed with peroxide of hydrogen instantly give off all their active oxygen, at the same time liberating the oxygen of the peroxide; therefore the active oxygen of either substance may be easily determined by using an excess of the other substance. The apparatus used is the ordinary nitrometer (compare this Journal, 1885, 495—496). A solution is made of 10grms. bleaching powder in 250cc. water, 5cc. = 0.2grm. are poured into the flask of the apparatus, and an excess, say 2cc.,

of commercial peroxide of hydrogen placed in the inner tube. The flask is then connected to the apparatus, the solutions mixed together by shaking, and the amount of gas evolved measured off in the usual way. The whole operation is complete in 1 to 2 minutes. The oxygen evolved is the direct measure of the active chlorine in the bleaching powder, so that after reduction to 0° and 760mm. pressure, each cc. of gas evolved, as above described, corresponds to 5 Gay-Lussac's degrees, or to 1.632 per cent. of chlorine. It is easier to weigh off 7.917grs. chloride of lime, dissolve in 250cc. of water, and to use for the test 5cc. of this solution, when every cubic centimeter of gas corresponds to 2 per cent. of chlorine. The great advantage of this process, is that it is entirely independent of any normal solution whatever; it also shows at once the amount of active oxygen or chlorine, is more quickly worked than any other, whilst at the same time is perfectly accurate.—T. L. B.

Standardising Iodine Solutions. W. Kalmann. Ber. 19, 728.

THE method at present in use for standardising iodine solutions, exact though it undoubtedly is, labours under the disadvantage of being somewhat complicated. The following simple method, which is based on the well-known fact that sulphuretted hydrogen acts on iodine with production of hydriodic acid and separation of sulphur, according to the equation—



is proposed by the author for determining the amount of iodine in a solution:—A certain volume of that solution is diluted with water and treated with sulphuretted hydrogen until completely decolourised. To the milky fluid thus obtained, methyl-orange is added, which gives no reaction with sulphuretted hydrogen, and the hydriodic acid may then be titrated with one-tenth normal alkali solution. As 1cc. of the latter represents 0.0127grm. I, the amount of the iodine in solution is readily calculated. A few examples of the working of this process are appended, and they fully bear out the statement as to its exactness.—A. R.

New Apparatus for the Estimation of Hydrogen Peroxide. M. de Thierry. Compt. Rend. 102, 611—613.

THE author describes an apparatus in which the hydrogen peroxide to be estimated is mixed with manganese dioxide, and the liberated oxygen is collected and measured under a graduated bell jar.—D. B.

Titration of Phosphoric and Arsenic Acids. A. Joly. Compt. Rend. 1886, 102, 316.

TO the acid solution a few drops of phthalcin are added, and titration with baryta solution follows until a gelatinous precipitate is produced. This is the tribarium salt, which on agitating with the acid liquid changes to the crystalline dibarium salt. On further addition of baryta solution a gelatinous precipitate again forms, which becomes crystalline in the same way. The process is complete when a drop of baryta gives a permanent red colouration. The change from the gelatinous to the crystalline condition is more rapid in the case of arsenic acid.—J. B. C.

Determination of Manganese. C. Reinhardt. Chem. Zeit. 10, 323.

THE author has shown that a double precipitation of manganese by Wolf's method should eliminate oxides of calcium and magnesium. The same method may be adopted for poor manganese ores. For 2—15 per cent. Mn 1grm. ore is taken, for above 15 per cent. Mn ½grm., below 2 per cent. 2grm. The ore is dissolved in HCl of sp. gr. = 1.19 (25cc. to 1grm. ore). The solution evaporated to dryness, moistened with dilute HCl, taken up with hot water, filtered through a double filter into a one-litre flask and washed with dilute HCl. The residue

is SiO_2 , insoluble Al_2O_3 and BaSO_4 . In very exact analysis this residue must be fused and the barium and aluminium separated from the SiO_2 . The filtrate from BaSO_4 containing the alumina is added to the previous filtrate, and the whole boiled with HNO_3 (10cc. HNO_3 of sp. gr. 1.4 for 1 grm. ore), and on cooling neutralised with ammonium carbonate, slightly acid ammonium acetate added and boiled. The mass is filtered into a 12-litre Erlenmeyer flask. The oxide of iron after washing is redissolved in HCl and treated again as above. This treatment is again repeated. Manganese is next precipitated: (1.) According to Wolff's method with a current of bromine-ammonia. To the filtrate contained in the Erlenmeyer flask 60cc. of 20 per cent. ammonia are added, and a current of bromine passed for 15–20 minutes; this is afterwards replaced by gaseous ammonia for 20 minutes. (2.) By means of bromine in HCl , ammonia and a current of gaseous ammonia. If the filtrate contains as much as 0.15 grm. manganese, 25cc. bromine in HCl are added, and then 60cc. of 20 per cent. ammonia, and a current of ammonia passed through for 20 minutes. With small quantities it is desirable to warm the solution. In other cases the solution becomes warm by the reaction. The author gives the preference to the first method, as the bromine is passed until no further precipitation occurs, whereas in the second case an excess of bromine in HCl must be avoided. In method (1) it is essential to pass the bromine through a tube furnished with manganese peroxide hydrate. The manganese precipitate may contain in addition hydroxides of Ni, Co, Fe, Cu, Zn (?), Ba, Ca, Mg and Si. After washing, the filtrate is removed and a 400cc. Erlenmeyer flask substituted into which 10–20cc. strong sulphurous acid are brought. The manganese precipitate is washed into this. The mass is heated when the precipitate is completely dissolved. If solution be not effected, 15cc. HCl of 1.19 are added. Into the solution brominated HCl is introduced until of a reddish tinge. After heating for some time the liquid is evaporated to dryness. In this way by the action of SO_2 upon MnO_2 , MnSO_4 is formed. The addition of Br oxidises the excess of SO_2 and the reduced iron. The sulphuric acid combines with any BaO present to form insoluble BaSO_4 . In case any Sr were present, evaporation brings it into the insoluble form. The mass, should a precipitate form, is filtered. The filtrate is heated to boiling in order to convert MnCl_2 into MnCl_3 , and after cooling 35cc. NH_4Cl (150 grm. in 1 l. H_2O) added, and a strip of litmus paper. Then 10 per cent. NH_4OH is added until just alkaline, and filtered directly into a flask containing 20cc. 50 per cent. acetic acid. The filter must be covered to prevent oxidation. The filtrate is now boiled in order to drive off chlorine in case any oxide of manganese is formed on the filter, and dissolved off with HCl . After cooling 10cc. NH_4Cl solution and 10cc. ammonia are added until alkaline, and filtered through the same filter as before. The precipitate is Fe_2O_3 , Al_2O_3 and possibly SiO_2 . If Mn settles out in the first precipitation with NH_4OH , it is filtered off and treated on the filter with dilute HCl and a few drops of SO_2 . The filtrate is boiled in this case with about 5cc. HNO_3 (1.4), then cooled, 25cc. NH_4Cl solution added and precipitation with 10 per cent. ammonia follows as stated. The acid filtrate is made alkaline with NH_4OH , and acidified with acetic acid until distinctly acid. The solution is heated on the water bath and H_2S passed through. This precipitates the sulphides of Ni, Co, Zn, Cu, etc. The filtrate contains the manganese. The liquid is heated to boiling, 10 per cent. NH_4OH added until alkaline, then colourless $(\text{NH}_4)_2\text{S}$, and the liquid boiled 10 minutes, cooled, a further quantity of $(\text{NH}_4)_2\text{S}$ added and the resultant filtered. The sulphide is dried and heated with sulphur in a Rose crucible in a current of hydrogen. According to Classen, the crucible must cool in a current of hydrogen and should have been heated over the blowpipe. The author adopts the following method: The MnS precipitate is dried, heated in a weighed crucible over the lamp, and finally over the blowpipe. The crucible is then cooled in the desiccator and the manganese weighed as Mn_3O_4 . The Mn_3O_4 is

then treated in the crucible with strong sulphurous acid and a few drops of dilute sulphuric acid, and heated on asbestos. A clear solution is obtained which is evaporated to dryness, and heated gradually to redness over the lamp flame. The manganese is then quickly weighed as sulphate. As a further check, the sulphate may be precipitated with bromine and weighed as Mn_2O_3 .

—J. B. C.

Determination of Phosphoric Acid in the Thomas-Slag.
J. Klein. Chem. Zeit. 10, 341.

AFTER reviewing the various methods at present adopted for the determination of phosphoric acid in slag, the author recommends the following scheme:—2.5 grms. are fused with a mixture of 4 parts of sodium-potassium carbonate and 1 part of potassium chlorate. The half of the latter is placed in a platinum crucible. The substance is brought on to the fusion mixture and the remainder of the latter added, and then the whole is well mixed with a glass rod. The mixture is heated over the Bunsen burner for some minutes, first with a small flame and then for another half-hour with a full flame. By placing the crucible upon a cold plate the contents are quickly cooled and contract to a loose cake, which may be readily withdrawn. This is placed in a beaker and treated with 50cc. HCl . An almost clear solution is obtained, which is diluted to 250cc. 100cc. are used for separating the silica in the usual way. The filtrate is made up to 200cc., in half of which the phosphoric acid is determined by means of ammonium molybdate.—J. B. C.

A Reagent for Detecting the Acidity of Weak Acids. R. Engel. Compt. Rend. 102, 214–217.

THE acid in question is dissolved in water, a few drops of a 1/1000 solution of soluble CLB blue (Poirrier) added and titrated with normal calcium hydrate solution until the colour changes to reddish violet. In this way phenol acts as a monobasic acid (in an alcoholic solution it is neutral), resorcinol acts as a dibasic acid. Morphine dissolved as hydrochloride requires 24 divisions of normal potash for neutralisation of the hydroxyl groups, the calculated quantity being 20 divisions; mono- and poly-basic alcohols and aldehydes cannot be titrated. Chloral acts as a monobasic acid. Hydrocyanic acid may be readily titrated with glyccol, alanine and taurine; the colour changes gradually and is slightly bleached.

—J. B. C.

Indicators for Determining the Basicity of Polybasic Acids. R. Engel. Compt. Rend. 102, 262–264.

IF the indicator soluble CLB blue (Poirrier) be employed, boric acid HBO_3 requires for neutralisation 1KOH; phosphoric acid H_3PO_4 , 3KOH; arsenic acid acts like phosphoric acid. Phosphorus, hypophosphorous, carbonic and *p*-oxybenzoic acids act as dibasic acids.

—J. B. C.

Determination of Rosin in Soaps and Fats. A. Grittner and J. Szilasi. Chem. Zeit. 10, 325.

AFTER reviewing the analytical methods at present employed, the authors propose the following, based upon Gladding's method. If a rosin soap is dissolved in about 80p.c. alcohol, and the solution if acid neutralised with ammonia, and an alcoholic solution of $\text{Ca}(\text{NO}_3)_2$ added, calcium stearate, palmitate and oleate separate out. A portion, however, of the oleate remains in solution. The resin remains also in solution. If silver nitrate be now added and the solution be largely diluted, oleic acid and resin separate out as silver salts. The further separation of rosin and oleic acid may be effected with ether, which leaves oleate of silver undissolved. The analysis is conducted as follows: 1–2 grms. of soap are dissolved in 80p.c. alcohol (5 vol. pure alcohol and 1 vol. water). If acid the solution is neutralised. $\text{Ca}(\text{NO}_3)_2$ in 10p.c. alcoholic solution is added in excess, cooled and filtered. After washing the precipitate with 80p.c. alcohol, AgNO_3 solution is added in excess to the filtrate and this is then diluted with

3 vol. of water. On agitating, the precipitate collects at the surface and may be readily filtered. The precipitate is washed with cold water, dried at 70–80° and digested with ether. After some time, the ethereal solution is filtered into a graduated 100cc. cylinder, and the precipitate washed with ether until it makes up 90cc. To the solution 10cc. of dilute HCl are added and the liquid is agitated. The HCl combines with the silver of the rosin salt and free rosin is formed, which is taken up by the ether. After the precipitate settles, 50cc. of the ethereal solution are drawn off, the ether is distilled off, and the residual rosin, after drying at 100°, weighed. The authors append a series of analyses made by aid of this method with weighed quantities.—J. B. C.

Determination of Fusel Oil. J. Traube. Ber. 19, 892–895.

IN order to test a brandy by means of the capillary-metrical apparatus, described by the author in the *Journal pr. Chim.* N.F. 31, 177 and 514, it is necessary to reduce it to the strength of 20 vol. per cent., before testing. The height to which the column of liquid ascends in the capillary tube, compared with a pure spirit of 20 vol. per cent. on an empirical scale, shows at once the amount of fusel oil the sample contains. Thus, an examination of a brandy can be made in a few minutes, and the fusel oil determined to one-fiftieth per cent with accuracy. The author gives a table of comparative tests made upon a spirit mixed with small quantities (1 to 0.1 per cent.) of various fusel oils, and also with pure amyl alcohol, the numbers for 0.5 per cent. and below this, agreeing very closely. Of twelve different brandies examined, only two or three contained over 0.1 per cent. fusel oil. The apparatus is to be obtained of C. Gerhard, in Bonn.—T. L. B.

Detection and Determination of Fusel Oil. Röse. Pharm. Centralb. 27, 5–9.

ETHYL-ALCOHOL is much less soluble in chloroform than the higher homologues which occur in fusel oil. If 50 per cent. alcohol be shaken with chloroform, the volume of the latter increases in proportion to the quantity of fusel oil present. The method of determination is based upon this principle. The alcohol to be tested is diluted with water to 50 per cent., and 100cc. are shaken with 20cc. chloroform in a graduated vessel at a temperature of 15°. With the aid of a table, the height of the layer of chloroform, and from this the quantity of fusel oil, is determined. If, for example, with pure alcohol the layer measures 37.1, with alcohol containing 1 per cent. amyl-alcohol, it increases to 39.1.—J. B. C.

Detection of Turpentine Oil. H. Hager. Pharm. Centralb. 26, 430–432.

THE reagent is guaiacum, which must have been powdered within two days. The reaction is an ozone reaction. In testing oils by their behaviour with turpentine oil and guaiacum—i.e., according to their absorptive power for ozone—such oils may be divided as follows:—(1) Those which readily form ozone; (2) those which in presence of guaiacum and turpentine oil produce ozone; (3) those which are indifferent in presence of these reagents. To perform the test two test glasses are taken, and into each a small quantity of recently powdered guaiacum, 10 to 20 drops absolute alcohol, and i.e. of the oil to be tested are brought. In the one glass (B) 4 to 5 drops of turpentine oil are added. After adding to each glass 1cc. benzene or other diluent, the mixture is boiled. If the oil belongs to group 2 the liquid in glass B becomes blue or violet, but not in the other glass A, if the oil is pure and unadulterated with turpentine. If neither glass change—i.e., if the oil belongs to group 3—one or more drops of oil of lemons or lavender or any oil of group 2 are added. Glass B shows at once, or on boiling, a blue colour, but not A, if the oil is free from turpentine.—J. B. C.

Reagent for Benzoic Acid sublimed from Gum Benzoin, and that sublimed over Resin. H. Hager. Pharm. Centralb. 26, 392–393.

THIS reagent is a mixture of FeCl_3 and K_3FeCy_6 solutions. The official substance from the resin changes the colour of the reagent in 1–3 seconds from yellow to blue, that prepared by subliming the acid over resin requires 20 seconds to 2 minutes to effect the change. Pure benzoic acid produces no effect with this reagent.—J. B. C.

A Reaction for Albumen. D. Axenfeld. Centralb. Med. Wissensch. 1885, 209–211.

SOLUTIONS of albumen, acidified with formic acid, to which 1 per mil. of AuCl_3 has been added, give, on heating, a rose red colour, on a further addition purple red, then deep blue, and with still more a blue flocculent precipitate, the liquor becoming colourless. This reaction indicates one in a million of albumen. In presence of foreign matter, as in urine, more acid and AuCl_3 must be added. Solutions of caoutchouc also give with these reagents a purple red colouration, but differ from albumen in changing with carbonates of the alkalis to orange yellow. The violet colour, which many other organic compounds produce, vanishes spontaneously, more quickly on addition of metallic mercury, but with albumen the colour remains unchanged.—J. B. C.

New Books.

DIE CHEMIE DES STEINKOHLENTHEERS MIT BESONDERER BERÜCKSICHTIGUNG DER KÜNSTLICHEN ORGANISCHEN FARBSTOFFE. Von Dr. GUSTAV SCHULTZ. Zweite vollständig umgearbeitete Auflage. Braunschweig: Druck und Verlag von Friedrich Vieweg und Sohn. 1886. London: H. Grevel, 33, King Street, Covent Garden.

THE first edition of this now well-known and excellent work was reviewed in this Journal, 1882, 162. A new edition, the second, now appears, and it is issued in parts at a price of 6s. per part. So far, Parts I. and II. are issued, covering 384 pages of subject-matter and dealing with the RAW MATERIALS. This division is further classified as follows:—COAL TAR, under which the composition, constituents, mode of working up, etc., are included. In the second division the INTERMEDIATE PRODUCTS and ASSISTANT PRODUCTS are treated of, and this treatment is also devoted to the Theory of the Aromatic Substances. Part I. ends on page 192, with an account of Diphenyl, and Part II. on page 384, with one of Phenyl- α -naphthylamine.

As above stated the work is entirely remodelled, and will be a complete treatise of the coal-tar colour industry, as well as of the collateral industries based on the coal-tar constituents or their derivatives. The pages of these two parts are embellished with 18 excellent woodcuts. The whole work when complete will form a somewhat thick 8vo volume.

A MANUAL OF THE ALKALI TRADE, INCLUDING THE MANUFACTURE OF SULPHURIC ACID, SULPHATE OF SODA, AND BLEACHING POWDER. By JOHN LOMAS. Second Edition, with Additions. London: Crosby Lockwood & Co., 7, Stationers' Hall Court, Ludgate Hill. 1886.

LARGE 8vo volume, bound in cloth, gilt-lettered, and illustrated with 232 excellent cuts and working drawings. The work contains 340 pages of subject-matter divided into chapters bearing the following

headings:—I. CHOICE OF SITE AND GENERAL ARRANGEMENT OF WORKS; II. SULPHURIC ACID; III. RECOVERY OF THE NITROGEN COMPOUNDS AND TREATMENT OF SMALL PYRITES; IV. THE SALT CAKE PROCESS; V. LEGISLATION UPON THE NOXIOUS VAPOURS QUESTION; VI. THE JONES AND HARGREAVES PROCESSES; VII. THE BALLING PROCESS; VIII. LIXIVIATION AND SALTING DOWN; IX. THE CARBONATING OR FINISHING PROCESS; X. REFINED ALKALI; XI. SODA CRYSTALS; XII. CAUSTIC SODA; XIII. BICARBONATE OF SODA; XIV. BLEACHING POWDER; XV. UTILISATION OF TANK WASTE; XVI. GENERAL NOTES. Next follow several Appendices—A, B, C, D, E. A refers to Mactear's Table of Products, from 100 tons of Pyrites; B, to Elaborate Tables of the Strength of Sulphuric Acid; C, to Fletcher's Anemometer, its construction, mode of employment, and tables of reference; D, to Foreign Legislation upon the Noxious Vapours Question; E, to a Summary of the Alkali Act of 1881. A copious and well-arranged Alphabetical Index closes the work, which, on account of its unique and exceptionally fine drawings and illustrations, must be of the greatest value alike to manufacturers and students of chemical technology.

Monthly Patent List.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

- 6086 C. H. Roeckner, F. L. Roeckner, and R. L. Roeckner, Tynemouth. Improvements in separating liquids from solids. May 26
 7289 M. Immisch, London. Apparatus for measuring heat. May 31
 8094 B. J. B. Mills, London—Communicated by C. T. Burcharth, Germany. A method of applying auxiliary heat to steam boilers, and means or apparatus for carrying it into effect. Complete specification. June 18
 8157 O. Imray, London—Communicated by F. Siemens, Germany. Improvements in regenerative gas retort furnaces. June 19
 8201 C. Langer, London. Improvements in apparatus for mixing, stirring, and conveying various substances, and for drying and exposing the same to the chemical action of gases, vapours, etc. June 21
 8212 T. T. Mathieson and J. Hawliczek, Liverpool. Improvements in and in connection with apparatus for distilling volatile liquids and gases. Complete specification. May 21
 6893 G. Sakasser, London. Improvements in an apparatus for filtration and purification of fluids. May 22
 6948 Y. A. Gaston, Viscount de Coetlogon, Liverpool. Improvements in apparatus for carburetting air. May 21
 6958 J. Gamgee, London. A method or methods of agitating liquids in the manufacture of ice, evaporating or other processes, and apparatus employed therefor. May 21
 7022 J. C. Mewburn, London—Communicated by J. Dietze, Germany. Improvements in surface cooling, heating, and condensing apparatus. May 25
 7045 J. B. Alliot and J. M. C. Paton, Manchester. Improvements in filter-presses and in apparatus connected therewith. May 26
 7065 J. F. Brinjes, London. Improvements in apparatus for separating liquids from solids, and for drying the solid residuum. May 26
 7088 G. F. Marshall, London. Improvements in filters. May 26
 7095 E. Sargeant, Birmingham. Improvements in water filters. May 27
 7101 J. C. Thresh, Manchester. Improvements in the manufacture of filtering materials. May 27
 7132 N. Greening, London. Improvements in apparatus for pulverising, brushing, and sieving minerals and chemicals. May 27
 7133 N. Greening, London. Improvements in apparatus for screening and carrying lime and other similar materials. May 27
 7202 A. M. Clark, London—Communicated by M. M. Bair, France. Improvements in reverberatory furnaces. May 28
 7328 J. L. Rigg, Knowle. Improvements in apparatus for the manufacture of transparent ice. June 1
 7106 G. Criner, London. Improvements in furnaces for the combustion of fuel. Complete specification. June 2
 7487 S. H. Adams, York. Improvement in appliances for the intermittent discharge of water or other liquid. Complete specification. June 4

- 7522 W. McCulloch, London. Improvements in filters. June 4
 7526 P. J. Davies, London. Improvements in fastenings for the lead linings of oil bleaching, sulphate of ammonia, evaporating, and other similar lead-lined tanks. June 4
 7768 A. Paget, London. Improvements in and connected with taps for gas and other fluids. June 9
 7988 W. G. Hudson, Manchester. Improvements in carburetting apparatus. June 15

COMPLETE SPECIFICATIONS ACCEPTED.*

1885.

- 7514 G. H. Bolton. Fastening device applicable to lids or covers of caustic soda or other drums, boxes, jars, etc., in which a nearly cylindrical part is required to be quickly fastened and loosed. June 18
 8530 E. Edwards—Communicated by L. Rohrmann and M. Hiller. Apparatus for effecting the absorption of gases or vapours by liquids. June 1
 9108 S. C. C. Currie and J. A. Timmis. An electric air pump. May 28
 9201 D. K. Clark and W. J. E. Feakes. Filter presses. June 8
 9231 H. W. Todd. Metallic drums for containing chemicals, etc. May 25
 9316 W. L. Wise—Communicated by J. G. Hansel and F. L. Krumblegal. Improvements in furnaces. June 22
 9387 W. Thomhison. Stoves for heating the blast for blast furnaces, etc. June 1
 9959 A. Bell. Filters. June 11
 15828 S. M. Lillie, Philadelphia, U.S.A. Process and apparatus for drying bone-black. June 22

1886.

- 2472 C. J. C. Bailey. An improved filter. June 11
 4096 J. Laidlaw and A. J. Liversedge. Construction of centrifugal machines or hydro-extractors. June 1
 5631 J. W. Holland. Apparatus for producing pressure or a varied degree of vacuum. June 18
 5731 J. R. Alsing. Improved triturating mill. June 18
 6310 C. C. Gilman. Improved means for filtering. June 18
 6348 O. Imray—Communicated by J. B. Archer. Boiler furnaces for combustion of gaseous fuel. June 22

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

- 6858 A. J. Boulton, London—Communicated by A. Montenegro, Spain. Improvements in the method of heating apartments. May 21
 6889 A. M. Clark, London—Communicated by C. A. Paquelin, France. Apparatus for automatically generating and burning inflammable vapours. May 21
 6919 E. Edwards, London—Communicated by K. Wehse, Germany. Improvements in heating stoves and furnaces. May 22
 6991 A. Brin, London. Improvements in apparatus for regulating the flow of and uniting and burning oxygen and hydrogen or other gases. May 25
 7112 W. S. Sutherland, Liverpool. Improvements in and applicable to gas producers. May 27
 7228 E. J. Barnfield, Halifax. Improvements in gas retort furnaces. May 31
 7258 R. Good, London. Improvements in hydraulic mains for gas-works. May 31
 7322 J. Bradley, Salford. Improvements in gas-lighting. June 1
 7375 F. Hill, Cheltenham. An improved apparatus for making and burning gas from petroleum and other similar oils. June 2
 7377 F. Radcliffe, Plumstead. Improvements in gas producers. June 2
 7401 J. Hepworth, Glasgow. Improvements in and connected with gas fires. June 2
 7484 G. Parker, Wrexham. An improved apparatus for heating steam boilers, glass furnaces, etc., with gas. June 1
 7578 J. H. W. Stringfellow, London. Improvements in lighting and heating, and apparatus therefor. June 5
 7580 C. F. Claus, London. Improvements in the purification of coal gas. June 5
 7581 C. F. Claus. Improvements in the purification of coal gas. June 5
 7582 C. F. Claus. Improvements in the preparation of ammonia compounds from coal gas. June 5
 7583 C. F. Claus. Improvements in recovering cyanogen compounds obtained in purifying gas. June 5
 7584 C. F. Claus. Improvements in the purification of coal gas. June 5
 7585 C. F. Claus. Improvements in the purification of coal gas. June 5
 7586 C. F. Claus. Improvements in the purification of coal gas. June 5
 7622 N. J. Holmes, Lewisham. Improvements in self-igniting and inextinguishable signal lights for marine and other purposes. Complete specification. June 7
 7705 J. Bartle, London. Improved appliance or means of adjusting and locking the handles of gas retort covers or lids. June 8

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Specifications thus advertised are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

7706 H. Cockey and F. C. Cockey, London. Improvements in gas purifier centre valves. June 8
 7733 T. Drake, Huddersfield. An improved method of manufacturing gas from benzoline or other similar suitable oil, and in apparatus employed therein. June 9
 7755 J. Holden, London. An improved injector for feeding furnaces with liquid fuel. June 9
 7770 J. Dredge, London. Improvements in apparatus for producing intense heat by gas. June 9
 7868 G. A. Biddell, London. Improvements in apparatus used in the production of gas from coal or other suitable substances. June 11
 8163 R. Stone, London. Improvements in the manufacture of fuel, and in machinery or apparatus used in connection therewith. June 19
 8207 G. Anderson, London. Improvements in apparatus to be used in the purification of coal gas. June 21

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

6938 T. S. Lindsay, London. Generating fixed gases for illuminating, heating, and metallurgical purposes. May 25
 8880 J. Hanson. Construction and arrangement of hydraulic mains and ascension pipes for the manufacture of coal gas. June 18
 9116 R. de Soldenhoff. A continuous arrangement of regenerating apparatus for coke ovens. May 25
 9298 A. H. W. Brown. Means for economising fuel and consuming smoke in steam boilers. June 18
 9477 H. H. Lake—Communicated by M. Ritter von Pichler. Apparatus for utilising the heat from lamps or candles for heating food, etc. May 28
 9591 J. McCulloch and W. Black, Glasgow. Machinery for preparing and compressing materials for use as fuel or for smelting purposes. June 22
 9731 W. B. Westlake. Apparatus for manufacture of artificial fuel, etc., and preparing materials for same. June 8
 10139 J. K. Field. Treating hydrocarbon bodies or substances. June 15
 12059 M. B. Parrington. Improvements in coke ovens, and in doors for the same. June 8

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

6853 J. G. Johnson, London—Communicated by The Farbenfabriken vormals F. Bayer & Co., Germany. Improvements in the manufacture of choline derivatives. May 21
 6965 C. D. Abel, London—Communicated by The Farbwerke vormals Meister, Lucius & Brüning, Germany. Improvements in the production of compounds of laevulinic acid, with the aromatic hydrazines. May 21
 7137 C. D. Abel, London—Communicated by The Farbwerke vormals Meister, Lucius & Brüning, Germany. Improvements in the production of indol-derivatives from the compounds of the aromatic hydrazines with the ketones and aldehydes. May 27
 7283 C. A. Martius, London. A process for the production of mixed azo colours from the diamido combinations of the ethers of diphenole. May 31
 7284 C. A. Martius, London. A process for the production of azo colours from the para-diamines of stilbene and florenone. May 31
 7910 W. E. Gedge, London—Communicated by Messrs. Ewer and Pick, Germany. Improvements in the manufacture of azo dyeing stuffs. June 12

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

9858 J. H. Johnson—Communicated by The Badische Anilin und Soda Fabrik. Manufacture of yellow and orange colouring matters suitable for dyeing and printing from dioxystartaric (carboxytartaric) acid. June 1
 10377 W. Clark—Communicated by The Farbfabrik vormals Branner. Production of colouring matters. June 15

1886.

6190 L. Landsberg. Preparation of *m*-methoxy-*p*-nitrobenzaldehyde for use in the manufacture of vanillin. June 11

V.—TEXTILES: COTTON, WOOL, SILK, ETC.

APPLICATIONS.

6908 W. B. Ritchie, London. Improvements in the manufacture of bituminous and other felts. Complete specification. May 22
 6916 J. Priestley, Wakefield. Chemically treating rags and the waste materials of silk, or combinations of silk with other animal or vegetable fibres. May 21
 7278 F. Mollet-Fontaine, London. Improvements in the treatment of vegetable textile materials, and of threads and fabrics made therefrom. May 31
 7634 L. A. Groth, London—Communicated by Holzer & Co., Germany. A new or improved method of cleansing wool and woollen fabrics. June 7

7735 W. M. Archer and J. Archer, Sandal, Yorks. Process for treating silk and silky rags for manufacturing purposes. June 9

COMPLETE SPECIFICATION ACCEPTED.

1885.

8795 C. D. Abel—Communicated by La Société Dubus, Coget et Cie. Removal of vegetable impurities from wool by chemical means, in combination with steam. May 28

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

6988 J. Smith, Manchester. Improvements in dyeing cotton, silk, wool, and other textile materials, either in the raw state or in the form of yarn, or as cloth in the manufactured state; and in apparatus therefor. May 25
 7083 T. R. Shillito, London—Communicated by The Zittauer Maschinenfabrik und Eisengiesserei, Germany. An apparatus for oxidising aniline black on woven fabrics. May 26
 7841 T. Holliday, London. Improvements in dyeing textile fibres. June 11
 8065 C. Lohmann, London. Improvements in dyeing blue, especially adapted for wool. June 17

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

7152 H. Willey, J. W. Robbs and J. S. Wallace. Method of and appliances for marking patterns on textile fabrics. June 11

1886.

6070 H. H. Lake—Communicated by C. N. Waite. Mordants for use in dyeing or printing calico and other fabrics. June 8

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

6824 D. G. McLellan, Glasgow—Communicated by P. K. Oushkoff and J. Y. McLellan, Russia. Improvements in the manufacture of sulphate of alumina. May 21
 6917 W. L. Wise, London—Communicated by Oesterreichische Anilin-fabrik Strakosch & Co., and C. O. Weber, Austria. Improvements in the manufacture of fluoride of aluminium, and compounds containing the same. May 22
 6999 W. C. Wren, London. A process of and apparatus for distilling ammonia. Complete specification. May 25
 7129 J. Y. Johnson, London—Communicated by C. Dubois, France. Improvements in apparatus for extracting and subliming sulphur. May 27
 7157 A. M. Clark, London—Communicated by M. Honigmann, Germany. An improved method of protecting copper vessels used for soda, steam boilers, and for evaporating the potash and soda lyes. May 27
 7192 A. Fritsch, London. Improvements in the manufacture of carbonic oxide gas. May 28
 7199 J. Brock and T. Minton, Widnes. Improvements in the manufacture of bleaching powder, and in apparatus for effecting the same. May 28
 7299 F. Maxwell Lyte, London. Improvements in the manufacture of lead sulphate and certain bye-products. May 31
 7355 H. H. Lake, London—Communicated by U. Cummings, United States. Improvements in the manufacture of sulphuric acid. Complete specification. June 1
 7395 P. M. Justice, London—Communicated by H. Y. Castner, United States. Improvements in the manufacture of sodium and potassium. June 2
 7603 C. Toppan, London. Improvements in bleaching compounds. Complete specification. June 8
 7801 J. Y. Johnson, London—Communicated by F. von Heyden, Germany. Improvements in the manufacture of salicylic acid, and of the substitution compounds and homologues thereof. Complete specification. June 10
 7859 B. Dawson, London. New or improved means or apparatus for evaporating waste lyes, and recovering soda from black liquor. June 11
 7861 M. Schwab, London. Improved method of treating and rendering innocuous liquid residuals of the manufacture of sulphate of ammonia and the like. June 11
 8018 M. von Nencki, London. Improvements in the manufacture of salicylic acid "esters." June 16
 8155 J. Y. Johnson, London—Communicated by C. Kolbe and C. Rentsch, Germany. An improvement in the manufacture of alpha- or beta-carbonaphthol acid alkaline salts. Complete specification. June 19

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

7867 A. Brin, London. Manufacture of bioxide of barium, and use of same in oxygenating water for bleaching, etc. May 25
 8182 F. W. Holloway. Improvement of sea salt or other salts for baths in lieu of sea-bathing, etc. June 11

8623 S. H. Johnson and C. C. Hutchinson. Preparing milk of lime, and apparatus therefor. May 25
 8692 F. Foster. Generating carbonic acid gas automatically. May 28
 9125 F. J. P. Cheesbrough—Communicated by J. Hawliczek. Manufacturing soda crystals and caustic soda direct from the bicarbonate resulting from the ammonia soda process, and recovery of ammonia and carbonic acid; and apparatus therefor. June 1.

1886.

5170 J. Maclear. Manufacture of hydrates of strontia and of baryta. May 25

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

6691 J. French and J. Craig, London. Process of manufacturing rolled plate-glass, and machinery employed therefor. June 22
 6873 F. H. It. Manchester. An improvement in earthenware pipes used for sewage and other purposes. May 22
 7123 G. Goodyear, Birmingham. Improvements in the decoration of glass vases and other objects. May 27
 7214 F. Gibbons, Brockmoor. Improvements in the manufacture of ceramic tesserae, mosaic, tiles, eggars, and other fictile goods, and in the machinery connected therewith. May 31
 7233 R. E. Donovan, F. Hazlett and A. Ross, Dublin. A new or improved method of blowing glass or other plastic substances. May 31
 7338 E. Picard, London. Improvements in or relating to the manufacture of glass. June 1
 8022 M. Schreiber, Manchester. Improvements in the method of annealing glass tubes, cylinders, hollow-ware, and analogous articles. Complete specification. June 16
 8023 F. S. Shirley, London. Improvements in the manufacture of glass, and articles therefrom. Complete specification. June 16
 8071 E. A. Cowper, London. An improvement in the moulding of ceramic vessels. June 17

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

7285 J. B. F. Frédeureau, London. Treatment of slate, schist, and waste thereof, for the production of material applicable for structures, vessels, and other uses. May 31
 7326 E. Brething, London. Improvements in the manufacture of roofing tiles, and in apparatus employed in this manufacture. June 1
 7361 H. H. Lake, London—Communicated by U. Cummings, United States. An improvement in the manufacture of cement. Complete specification. June 1
 7438 E. Kerry and E. C. Kerry, Highgate. The improved formation of building bricks. June 3
 7492 W. Brierley, Halifax—Communicated by F. Wallbrecht and H. Russe, Germany. Improvements in the manufacture of artificial elaterite or elastic bitumen, to be employed in road-making, roof-surfacing, and other like purposes and uses. June 4
 7617 H. Diedrich, Liverpool. Improvements in tiles. Complete specification. June 7
 7671 H. Mathey, London. Improvement in the manufacture of cement. Complete specification. June 8
 7675 H. Mathey. Improvement in the manufacture of cement. Complete specification. June 8
 7676 H. Mathey, London. Method of colouring cement. Complete specification. June 8
 7745 H. Poole, London. Improvements in compositions for artificial stone, cement, and analogous uses. June 9
 7762 H. R. Snelgrove, Clapham. The more perfect calcination of Portland cement, the better preservation of its qualities during transport in bulk by sea, and for other advantages associated with its manufacture. June 9
 7888 F. W. S. Stokes, Kensington. Improvements in the processes and manufacture of cement in a powdered state, and the apparatus relating thereto. June 12
 8067 P. J. Milligan, Glasgow. Improvements in and connected with the manufacture of bricks. June 17
 8120 S. Lowden, London. Improvements in the manufacture of Portland cement. June 18

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

9017 J. H. Wood. Ovens for drying slurry and similar substances. May 28
 9789 W. P. Thompson—Communicated by G. Lilienthal. Improvements in manufacture of artificial stone. June 1

1886.

5994 G. Marcion. Process for preserving timber. June 4
 6061 L. A. Groth—Communicated by F. L. Perriere. Roofing tiles. June 22

X.—METALLURGY, MINING, ETC.

APPLICATIONS.

6974 E. Hunt, Glasgow—Communicated by G. Thomson, United States. Improvements in obtaining copper from solutions of its salts. May 25
 6977 C. J. Sandahl, G. Bargate, and C. B. Phillips, Chester. The manufacture of ferro-manganese, silico-spiegel, spiegelisen, and chrome-iron. May 25
 6992 L. L. Sagendorph, London. Improvements in machines for corrugating sheet metal. Complete specification. May 25
 7008 W. Evans, London. Improvements in apparatus for manufacturing steel sleepers and other metallic articles. May 25
 7191 A. Fritschl, London. Improvements in smelting iron and other metallic ores, and apparatus therefor. May 28
 7371 D. Caddick, Middlesbro'. Furnaces for heating and melting iron or steel, with improved brick for building furnaces, etc., manufactured from old material with a certain admixture of fire clay. June 2
 7462 W. C. Tweney, London. Improvements in machinery or apparatus for blowing, refining, preparing, and purifying molten metals. June 3
 7637 G. D. Fitzgerald, London. Improvements in separating and obtaining gold and silver from their alloys with each other and with other metals. June 7
 7777 W. Briggs, Arbroath. Improvements in the process for preserving iron and steel structures from oxidation. June 10
 7796 P. Jensen, London—Communicated by The Deoxidised Metal Co., United States. A process for deoxidising metals. June 10
 8130 J. Noad, London. Improvements relating to the extraction of gold, silver and copper from ores and other substances or products containing such metals. Complete specification. June 18

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

6633 F. Siemens. Construction of open hearth or tank furnaces for melting iron and steel, etc. June 1
 8235 P. J. Davies. Apparatus for lead burning. May 25
 8906 H. W. Hollis. Improvements in rolling and forging metals. June 8
 9009 W. H. Walton. Process of preparing copper for casting. June 4
 9883 G. Leyshon. Method of and apparatus for manufacturing tin andterne plates or sheets, and for galvanising sheets of iron. June 15
 10237 O. M. Thowless. Soldering aluminium, and preparing aluminium for such soldering. June 4
 12485 F. W. Koffler and E. Zwierzina. Process of and means for coating sheet metal with zinc. June 11

1886.

1872 A. J. Boulton—Communicated by L. W. Sinsabaugh. Reducing steel railroad rails to plate metal. June 18
 3448 F. Brain. Shot firing and blasting in mines by the agency of electricity. June 18
 6128 G. Craig. Treatment of blast furnace or other slags for obtaining useful products therefrom. June 8
 6367 P. A. Newton. Communicated by C. A. Paillard. Metallic alloys. June 18
 6372 H. H. Lake—Communicated by E. E. Wood. Rolling and welding iron and steel, and fluxes therefor. June 18
 6404 A. Gutensohn. Process for coating the surface of iron or other metals with tin, lead, or terne. June 15

XI.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

6981 R. Jaques, Newcastle-on-Tyne. Improvements in toilet soap tablets. May 25
 6989 A. Watt, Manchester. An improvement in the manufacture of a compound for washing and cleansing purposes, and apparatus to be used in its manufacture. May 25

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

9352 M. Bauer—Communicated by J. Merz. Extracting fat, etc., from dissolvable materials, and apparatus therefor. May 25
 12305 R. Livesey, London—Communicated by Dr. Duncan. Liquid soap. June 22
 13361 A. T. Hall, London. Refining vegetable oils. June 22

1886.

6172 F. P. Warren. Improvements in lubricants. June 15

XII.—PAINTS, VARNISHES, AND RESINS.

APPLICATIONS.

6815 W. Corbould, Peckham. Improvements in manufactured whitening, to be called Corbould's sanitary whitening. May 21

- 7374 J. Blain, Manchester. Improvements in the manufacture of shoe blacking. June 2
 7197 J. Cameron, Glasgow. Improvements in anti-fouling compositions for ships. June 4
 7917 H. F. A. Prinzhorst, London. Improvements in the manufacture of hard rosin. June 12
 7955 A. Buck, London. Improvements in the method of and in apparatus for drying pigments and other comminuted pasty substances. Complete specification. June 15

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 10109 H. Gardner—Communicated by D. Lublinski. Compound for application to wood, metal, or other substance as a paint or varnish to prevent decay, rust, or other injury by atmospheric action. June 22

1886.

- 4736 H. E. Newton—Communicated by H. M. Hanmore, R. Van Selous Mattison, and H. G. Keasbey. Non-conducting composition and covering for pipes, vessels, and receptacles. June 4
 5270 J. B. Melvin. Manufacture of resinous compounds. June 1

XIII.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

- 7145 A. H. Mangin, London. A new product for depilating and preserving hides. May 27
 7274 T. Brain, Peckham. The continuity system of tanning. May 31
 7692 W. P. Thompson, Liverpool—Communicated by J. W. Fries, United States. Improvements in tanning. Complete specification. June 8
 7743 E. P. Nesbit, London. An improvement in tanning light hides or skins. June 9
 7744 E. P. Nesbit. An improvement in tanning. June 9

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 12302 H. E. Howe. Method of rendering leather more durable, pliable, and proof against damp. May 25

1886.

- 5491 N. A. Alexanderson and L. Hvass. Method of tawing hides and skins. May 28
 6668 A. J. Boulton—Communicated by G. E. Kasemodel. Treatment of leather, and an improved mixture therefor. June 18

XIV.—AGRICULTURE, MANURES, Etc.

APPLICATION.

- 7510 W. G. Gard, London. A manurial insecticide. June 1

COMPLETE SPECIFICATION ACCEPTED.

1886.

- 5686 H. J. Allison—Communicated by W. S. Pierce. Fertilising compounds, and process of manufacturing the same. May 28

XV.—SUGAR, GUMS, STARCHES, Etc.

APPLICATIONS.

- 7186 F. Bauder, London. An improved process for manufacturing perforated or figured sugar tablets or blocks. Complete specification. May 28
 7524 R. Dick, Glasgow. Improvements in gutta-percha compounds, and in the manufacture thereof. June 1
 7950 M. Blake and J. Barclay, Glasgow. Improvements in and connected with sugar mills. June 15

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 8857 C. Lyle and J. Lyle. Apparatus for cleansing sugar in centrifugal machines. May 25
 10110 A. C. Henderson—Communicated by G. Durozad. Manufacturing sugar from amylaceous and cellulose matters. June 1

XVI.—BREWING, WINES, SPIRITS, Etc.

APPLICATIONS.

- 7325 P. M. Justice, London—Communicated by J. D. Hazlett and W. R. Bennett, United States. Improvements in apparatus for automatically supplying gas to beer or like beverages. Complete specification. June 1

- 7591 A. J. Boulton, London—Communicated by H. A. O. P. Lissagaray, France. Improvements in the treatment of alcoholic liquors or other stimulants or liquors. June 5
 7619 J. Death, London. Improvements in preserving beer. June 7
 8082 W. S. Squire, London. Improvements in the manufacture of yeast. June 17
 8161 Sir F. Bolton, London. A process for cleaning or fining beer. Complete specification. June 19

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 8921 A. Ralu, fils, J. Grathvold and H. A. Browne. Preparing and treating syrups and molasses by mixing them with substances adapted for distillation, and manufacturing spirit therefrom. May 28
 9950 H. H. Lake—Communicated by A. E. Ferve. Manufacture of syrup and beer from maize and malt. June 22

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

APPLICATIONS.

A.—CHEMISTRY OF FOODS.

- 7303 C. Hoorn, London. Improvements relating to the preservation of milk. May 31
 7644 H. H. Lake, London—Communicated by N. Muller, Russia. Improvements relating to the preservation of alimentary substances. June 7
 7815 G. Porter, London. A preparation of food for dogs and other animals, game, and poultry. Complete specification. June 10
 7842 H. W. Hart, London. A new food compound. June 11
 7862 G. Grout, Hornsey. An improved preparation of cocoa and chocolate. June 11

B.—SANITARY CHEMISTRY.

- 6819 W. Thomson, Manchester. The employment of certain substances for antiseptic purposes. May 21
 7174 H. Fewson, London. Improvements in the treatment of sewer and other similar noxious gases. Complete specification. May 28
 7333 J. Fenton, Leeds. An improved means of purifying, precipitating, and filtering sewage, drainage, and the like matters. June 1
 7536 J. W. Fereday, London. Improvements in the construction and arrangement of tanks for treating sewage. June 1
 7730 G. V. Alsing, Sheffield. Improvements in the treatment of sewage and other polluted waters and their deposits, and in apparatus employed therein. June 9
 8087 J. C. W. Stanley, London. Improvements in the method or process for recovering combustible matters from town and similar refuse, and an improved manufacture of fuel therefrom. June 17
 8088 J. C. W. Stanley. Improvements in the treatment of road sweepings, and in apparatus therefor. June 17
 8144 H. R. Newton, Weybridge. Improvements in drainage and drainage works applicable to towns or to country districts; and also for improvements in dealing with sewage and waste waters. June 19

C.—DISINFECTANTS.

- 6966 H. M. Caldwell, London. An improved deodorant and disinfectant. May 24
 7324 W. H. Bibby, Preston. An improved disinfecting, deodorising, and fumigating powder. June 1
 7386 E. Foster, Preston. Fumigating, disinfecting, and deodorising purposes. June 2

COMPLETE SPECIFICATIONS ACCEPTED.

A.—CHEMISTRY OF FOODS.

1885.

- 9437 W. W. Nightingale. Means for forming and maintaining ice surfaces, and treating the atmosphere of glaciers or cooling chambers. June 22

B.—SANITARY CHEMISTRY.

1885.

- 13761 G. W. Bremner. Treatment of chemical agents, and employment of the resultant for the precipitation, clarification, and defecation of sewage. June 8

1886.

- 6520 G. R. Redgrave. Treatment of sewage-water by the lime process for the production of cement. June 15

C.—DISINFECTANTS.

1885.

- 9353 W. R. Lake—Communicated by M. R. Garcia. An improved disinfectant. May 25
 10130 H. H. Lake—Communicated by C. Collin et Cie. Manufacture of an improved antiseptic. June 11

XVIII.—ELECTRO-CHEMISTRY.

APPLICATIONS.

- 6845 P. Bailly, London. Improvements in primary and secondary batteries. Complete specification. Nov. 6, 1885.
- 6869 C. Clamond, London. Improvements in the transformation of heat into electricity, and in apparatus for that purpose. May 21.
- 6921 J. T. Armstrong, London. Improvements in or relating to the construction and working of electrical batteries. May 22.
- 6957 M. Kotyra, London. Improvements in galvanic batteries. May 21.
- 6969 G. V. Lagarde, London. Improvements in and relating to electric batteries. May 21.
- 7002 A. H. Reed, London—Communicated by J. T. Williams, United States. A new or improved electro-magnetic transmitter. Complete specification. May 25.
- 7004 R. E. R. Crompton, London. Improvements in apparatus for generating currents of electricity and in electro-motors. May 25.
- 7028 G. F. Rose, London. Improvements in primary electric batteries. May 25.
- 7117 E. Tuteur, London. An improvement in or connected with galvanic batteries. May 27.
- 7189 J. E. Pearce, London. An improvement in primary voltaic batteries. May 28.
- 7270 P. W. Williams, London. Improvements in combined dynamo-electric machines and motors. May 31.
- 7277 A. Le Neve Foster and F. V. Andersen, London. Improvements in dynamo-electric machines and electric motors. May 31.
- 7279 A. H. Byng, London. A regulator for high-tension electric currents. May 31.
- 7312 R. H. Courtenay, London. Improvements in the method of, and an amalgam for amalgamating zinc or other metal plates, such amalgam being alone applicable for voltaic electric elements. June 1.
- 7353 P. R. de Fumcheux d'Ifumy, London. Improvements in galvanic batteries. June 1.
- 7376 V. Nowak, Vienna. Improvements in automatic regulators for electric currents. June 2.
- 7426 C. Petri, London. Process for the production of the ferri-cyanides of potassium, sodium, and ammonium by electrolysis. Complete specification. June 2.
- 7440 T. Parker, Wolverhampton. Improvements in the winding and connection of dynamo machines with accumulators. June 3.
- 7474 W. T. Whiteman, London—Communicated by R. J. Gulcher, Germany. Improvements in secondary batteries. June 3.
- 7544 H. J. Smith, London. Improvements in dynamo-electric machines. Complete specification. June 4.
- 7561 J. Gibson and F. M. Gibson, Glasgow. An improved electrode. June 5.
- 7576 J. A. Kingdon, London. Improvements in dynamo-electric machinery. June 5.
- 7596 J. Pitkin, London. An improvement in the construction of elements for secondary batteries or accumulators. June 5.
- 7636 D. G. Fitzgerald, London. Improvements in the preparation or manufacture of negative elements for voltaic batteries. June 7.
- 7704 E. J. Houghton, Peckham. Fuse for dynamo-electric machines. June 8.
- 7818 C. Smith, London. Improvements in secondary batteries. June 11.
- 7860 S. P. Thompson, London. Improvements in dynamo-electric machines. Complete specification. June 11.
- 7953 W. Geipel, Edinburgh. Improved method of regulating currents generated by dynamo-electric generators. June 15.
- 7966 E. Commelin, G. Bailbacko, C. Desmazures, A. Lebrun de Virloy, and L. de Bousignac, London. Certain new and useful improvements in secondary batteries acting as accumulators of electricity. June 15.
- 7983 A. Serrailier, London. An improvement in the construction and automatic regulation of primary batteries. June 15.
- 7997 J. E. Chaume and P. Perrier, London. Improvements in accumulators of electricity. June 15.
- 8003 L. B. Atkinson, W. T. Gooden, and A. P. Trotter, Halifax. Improvements in dynamo-electric generators and motors. June 16.
- 8040 C. Ziperowski, M. Deri, and O. T. Blathy, London. Improvements in regulating alternating electric currents. June 16.
- 8081 A. M. Clark, London—Communicated by C. R. Goodwin, France. Improvements in voltaic batteries. June 17.
- 8151 J. G. Tongue, London—Communicated by J. Kirby, Belgium. Improvements in the manufacture of carbons for electrical purposes. Complete specification. June 19.

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 8717 A. I. Gravier, London. Machines for generating electro-motive power. June 8.
- 9522 C. P. Elieson. Electrical accumulators. May 25.
- 9526 T. J. Handford—Communicated by F. J. Sprague. Electro-dynamic motors. June 15.
- 9580 A. Muirhead and C. R. Alder Wright. Preparation of insulating compounds for electrical purposes. June 1.

- 9896 H. J. Haddon—Communicated by K. Pollak and G. Wehr. Improved galvanic element or battery. May 25.
- 10041 S. H. Emmens. Compound galvanic batteries, and method of working the same. June 8.

1886.

- 1937 W. R. Lake—Communicated by W. E. Case. Conversion of heat energy into electrical energy, and apparatus therefor. May 25.
- 5611 H. H. Lake—Communicated by The Helios Electric Light and Telegraph Construction Company. Machinery or apparatus for the generation of electric currents. June 4.

XIX.—PAPER, PASTEBOARD, ETC.

APPLICATIONS.

- 7305 F. L. Teed and H. W. Teed, London. Improvements in the manufacture of sensitised paper, cloth, or the like, for copying drawings, and for similar purposes. May 31.
- 7453 J. Morley, London. Waterproofing millboard, paper, and cardboard for advertising tablets, posters, and signs. June 3.
- 7530 E. de Pass, London—Communicated by La Société de Lafarge, Lebré et Cie., France. A process and apparatus for rendering all kinds of paper impermeable and transparent; the said apparatus being likewise applicable for rendering cotton or other fabrics impermeable. June 4.
- 7562 J. Gibson and F. M. Gibson, Glasgow. Improvements in the manufacture of paper and analogous materials. June 5.
- 7633 L. A. Groth, London—Communicated by H. Schnurman and G. Closs, Germany. A new or improved process and apparatus for manufacturing sulphite cellulose in beton boilers. June 7.
- 7901 C. Weygang, London. Improvements in waterproofing and sizing paper and such like material. June 12.
- 8039 E. Thiebaud and C. Thiebaud, London. An improvement in the manufacture of coloured paper, plain or ornamented. June 16.
- 8148 C. Morfit, London. Improvements in the manufacture or treatment of paper. June 19.

COMPLETE SPECIFICATION ACCEPTED.

1885.

- 9575 W. B. Woodbury and F. Vergard. Method of making paper transparent to render it suitable as a substitute for glass for photography, etc. June 22.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

APPLICATIONS.

- 6899 S. Waters, London. Improvements in tonic bitters. Complete specification. May 22.
- 7903 W. L. Wise, London—Communicated by E. Mourlot, fils, France. Obtaining certain products or substances from essence of birch-bark, and utilising the same in the manufacture or production of certain compounds or substances. June 12.

XXI.—EXPLOSIVES, MATCHES, ETC.

APPLICATIONS.

- 7323 D. F. Downing, Woolwich. Improvements in the manufacture of certain explosives. June 1.
- 7407 A. M. Clark, London—Communicated by H. J. Smith, United States. Improvements in electric fuses for pyrotechnical and other purposes. Complete specification. June 2.
- 7911 J. Rigby, London. Improvements in ammunition. June 12.
- 8032 A. V. Newton, London—Communicated by A. Nobel, France. Improvements in explosive compounds. June 16.
- 8033 A. V. Newton, London—Communicated by A. Nobel. Improvements in detonators. June 16.
- 8127 T. Nordenfellt, London. Improvements in fuses. June 21.

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 10110 W. F. Ruston. Detonating fog signals for railways. May 28.
- 11112 C. D. Abel—Communicated by F. Guens. Explosive compound for firearms and blasting purposes. June 11.

1886.

- 6310 E. L. Zalinski. Fuses for explosive shells and torpedoes. June 15.
- 6661 H. Schöneweg. Explosive compounds. June 18.

THE JOURNAL

OF THE

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NOTICES.

The attention of members is requested to the copy of the new Bye-Laws accompanying this issue of the Journal, as it supersedes all previous copies and renders them useless.

The supply of copies of the Journal for January, 1882, being now exhausted, the Secretary would be glad to receive communications from members possessing extra copies of that number, in good condition, with a view to purchase.

Should sufficient applications for complete sets be received, the number will be reprinted.

CHANGES OF ADDRESS.

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LIST OF CANDIDATES FOR ELECTION—JULY 30, 1886.

J. B. Aitken, Gerard's Fold Chemical Works, Widnes, chemical manufacturer.
 Andrew Campbell, 14, E. Thirlestane Road, Edinburgh, analyst.
 John Campbell, 25, New Chambers Street, New York, U.S.A., aniline dye manufacturer.
 Malcolm E. Chisholm, S. Kennington Park Road, London, S.E., technical chemist.
 Eardley Bailey Denton, Palace Chambers, Westminster, S.W., civil engineer.
 J. Doughty, Union Oil Mills, 251, Rotherhithe Street, S.E., superintendent.
 Wm. Crake, Corral Quemado, Andacollo, Coquimbo, Chili, analyst.
 Arthur Fielding, 22, Dantzic Street, Manchester, drysalter.
 F. A. Gatty, Elmfield Hall, Accrington, dyer and calico printer.
 P. Eugen Heer, 311, Oldham Road, Newton Heath, Manchester, dyer.
 Edw. Mallinckrodt, chemical works, St. Louis, Missouri, U.S.A., manufacturing chemist.
 John Metcalf, Henry Street, Church, Accrington, manager, tar distillery.
 Chas. Moseley, Grangeorpe, Rusholme, Manchester, india-rubber manufacturer.
 Henry Peaty, Longport, near Stoke-on-Trent, gas engineer and manager.
 Wm. Ross, 12, King Street, Manchester, chemical and mineral merchant.
 Alphonse Steiger, 16, Mincing Lane, London, E.C., consulting engineer.
 Cuthbert Vaux, The Brewery, Sunderland, Brewer.
 E. Robinson Walker, 18, St. Ann's Street, Manchester, patent agent.
 Chas. Williams, 1, Leadenhall Street, London, E.C., chemical engineer.

PROCEEDINGS OF THE FIFTH ANNUAL MEETING.

The Annual Meeting was held on Wednesday morning, July 14, at eleven o'clock, in the new Chemical Theatre of the University College, Liverpool. The chair was taken by the President, Mr. E. K. MUSEPRATT, who, after the reading of the minutes of the last annual meeting and their confirmation, called upon the General Secretary to read the

REPORT OF THE COUNCIL.

The Society of Chemical Industry now contains 2271 members, residing in and about the following districts:—London, 642 members; Liverpool, 184; Manchester, 312; Newcastle, 120; Birmingham, 112; Glasgow, 251; Bristol, 73; Nottingham, 75; Yorkshire, 121; Ireland, 30; parts of England and Wales not included in any of the above, 115; United States and Canada, 96; and other Countries, 140. Since the last Annual Meeting 266 members have been elected, and 86 have been lost by death and other causes, making a net gain of 180 members.

Among the names of those who have died, that of our late President, Mr. Walter Weldon, F.R.S., who passed away somewhat suddenly on the 20th of last September, stands foremost. His services to the Society were so important, and must be so fresh in the minds of all its members, as to render an extended reference to them here superfluous. In him Chemical Industry has lost a most devoted servant, and one whose place it will be difficult to fill. During his year of office he had expressed an intention of leaving to the Society his collection of scientific, technical, and chemical works. Death came upon him too suddenly to enable him to effect this disposition in writing; but his son, Mr. Raphael Weldon, has, nevertheless, agreed to fulfil his father's known intention. The Society thus becomes possessed of a thousand or more valuable works, which will form the nucleus of a reference library.

Other noteworthy losses are Mr. H. S. Evans, Chief Analyst of the Dominion of Canada, and formerly President of the Pharmaceutical Society; and Mr. Alfred Tribe, Professor of Chemistry at Dulwich College,

who was well known for his researches on the zinc copper couple.

The Council has received no applications for its consent to the formation of new sections during the year; at the same time the increasing number of members in Yorkshire encourages the belief that at no distant period of time a section will be in operation in that district. Members residing in and near Edinburgh have now resolved to form a joint section with those at Glasgow; and in future the united body is to be known as the "Glasgow and Scottish" section, due provision being made for the representation of the East of Scotland on the Committee.

Original papers read before the various sections show an increase upon the seventy-one recorded last year. Manchester heads the list with 18, Glasgow 17, London 16, Birmingham 7, Liverpool and Newcastle 6 each, and Nottingham and Bristol 5 each; making, with the two read before the last Annual Meeting, a total of 82. To their authors, as well as to those officers of sections whose zeal has elicited so much valuable information, the best thanks of the Society are due.

The Journal continues to maintain its position, and affords evidence of progress. For the guidance of the Publication Committee, Editor, and Abstractors, an amended set of rules has been drawn up by the President, Editor, and others; and after careful revision by the Publication Committee, has received the sanction of the Council. The "List of Patents Published" having been found of little use, has been replaced by a list of "Complete Specifications Accepted." Members will find this list to afford not only earlier information, but if they wish it an opportunity to lodge objections within the prescribed time. In 1882 each number of the Journal averaged 43 pages of matter; in 1883, 47; in 1884, 56; in 1885, 65 pages. The increase of cost has been more than proportional to the increase of matter, owing to the abundance of woodcuts, tables, and diagrams, which illustrate the papers. If this is to be maintained, the Society must receive still more support from the Chemical Industries.

In accordance with the expressed wish of the Liverpool and Manchester Sections, arrangements are being made to hold the meetings of the Publication Committee during the next six months in Manchester, in order to permit Northern members to attend more frequently. The Editorial Committee has been abolished, and in future each section will appoint an Editorial Committee to examine its own papers before sending them to be printed, and for the revision of discussions. It is hoped that these arrangements will conduce to economy in the production of the Journal.

The Council has to ask the approval of the members for certain alterations in the Bye-laws, one or two of which are of importance to the welfare of the Society, and are worthy of careful consideration. The most important of all deals with the subscription. Three alternative propositions have been before the Council—viz., the imposition of an entrance fee, the raising of the subscription to 30s., and the raising of the subscription to 25s. It has been resolved to recommend the last of these alternatives. The reasons which have induced the Council to ask for increased support are the following:—For several years the balance between receipts and expenditure has shown either a deficit or so narrow a surplus as to leave no margin for contingencies. This is due mainly to the cost above referred to of producing the Journal, but also in some degree to the subventions granted to sections, the levy of a special local subscription having been found impracticable. The amount paid for sectional expenses during the past

session has been £223 1s. 2d., or about 2s. 6d. per sectional member.

The Journal, when we consider the amount of valuable information contained therein, is alone well worth the proposed addition to the subscription, without taking into account the other advantages which the Society affords. Another proposed alteration will give the Council power to withhold the Journal from any member until his subscription for the current year has been paid. This plan is adopted by other societies with good results.

In conclusion, the Council expresses a hope that the existing depression among the Chemical Industries may soon pass away; and that the work which this Society has been formed to achieve may bear fruit in the shape of increased prosperity to existing industries and the establishment of new manufactures.

Sir HENRY ROSCOE, M.P., moved that the report be adopted.

This motion, seconded by Mr. A. NORMAN TATE, was carried unanimously.

The Report of the Treasurer was then read.

SOCIETY OF CHEMICAL INDUSTRY.—TREASURER'S STATEMENT FOR THE YEAR 1885.

	Dr.	£	s.	d.
To Cash on Deposit (31st December, 1884)	£600	0	0	
Balance at Bank, ditto	176	5	0	
Less amount owing to Secretary	£1	6	6	
	174	18	6	
Annual Subscriptions:—				
4 for the year 1883	£4	4	0	
23 for the year 1884	24	3	0	
1911 for the year 1885	2638	1	0	
36 for the year 1886	37	16	0	
2004 Excess payments	0	3	3	
	2104	7	3	
Life Composition Fees	105	0	0	
Interest on Deposit Account	20	12	9	
Amount received from Council of the International Inventions Exhibition	131	17	5	
Journal:—				
Advertisements	£106	4	2	
Sales	212	11	3	
	318	15	5	
	£3488	11	4	

Tate, Dr. Ad. Liebmann, and Mr. Alexander Watt, Whilst the scrutiny of the votes was proceeding, the President delivered his Address.

PRESIDENT'S ADDRESS.

On behalf of the Local Section, I have to welcome the members of the Society to Liverpool, the principal commercial centre of the large Chemical Industries of this country, and, in conjunction with Manchester, the birthplace of the Society itself.

More than 50 years ago Liverpool contained several soap and glass works, and here the manufacture of alkali was first carried out on a large scale, but the town itself has long ceased to be the principal seat of these manufactures, which have migrated to the neighbouring towns of St. Helens, Widnes, Runcorn, and Flint, and together with large works for the extraction and smelting of copper, form the staple industry of this portion of the County of Lancaster.

Having these industries principally in view, when the formation of the Society was first discussed, it

	Cr.	£	s.	d.
By Journal Expenses:—				
Publishing	£1312	6	8	
Editorial	608	13	7	
	1921	0	3	
Printing Sundries	83	5	3	
Sectional Expenses:—				
Birmingham Section	£8	0	3	
Bristol Section	2	17	2	
Glasgow Section	44	18	6	
Liverpool Section	27	14	11	
London Section	17	15	3	
Manchester Section	56	8	0	
Newcastle Section	25	11	2	
Nottingham Section	26	0	1	
	219	5	1	
Secretary's Salary	200	0	0	
Honorary voted to Edward Hughes for assistance rendered to Hon. Treasurer in 1881	21	0	0	
Office Expenses:—				
Rent	£61	8	9	
Fires, Cleaning, Attendance, etc.	12	18	3	
Gas	0	8	5	
	71	15	5	
Stationery	38	8	4	
Amount paid on Account of Expenses in connection with the Inventions Exhibition	120	1	8	
Portions of Life Composition Fees returned (overpaid)	10	0	0	
Auditors' Fees	3	3	0	
Bank Charges on Scotch and Irish Cheques, etc.	1	1	3	
Secretary's Petty Cash:—				
Postage, Telegrams, etc.	£22	0	6	
Carriage of Parcels	0	5	10	
Travelling Expenses	0	10	11	
Gratuities	2	6	6	
Stationery, etc.	1	2	0	
Expenses of Meetings	2	14	9	
Sundries	1	9	5	
	30	9	11	
Treasurer's Petty Cash:—				
Postage	£11	19	1	
Fares, Carriage of Parcels, etc.	0	3	0	
Stationery	0	8	6	
Law Charges	0	8	0	
Telegrams, P.O. Orders, etc.	0	2	8	
Fire Insurance Premium	0	2	6	
	13	3	9	
Cash on Deposit (31st December, 1885)	£600	0	0	
Balance at Bank, ditto	141	13	1	
Balance in Secretary's hands, ditto	11	0	10	
	752	14	2	
	£3488	11	4	

We have examined this Account of Receipts and Expenditure, and certify it as correct.

19th February, 1886.

THEABALD BROS. & MIALL,
Chartered Accountants.

ELECTION OF OFFICERS AND COUNCIL FOR THE ENSUING YEAR.

The scrutineers appointed to examine the balloting papers were—Mr. A. E. Fletcher, Mr. A. Norman

was proposed to call it the Society of Chemical Engineers, since of late years the greatest improvements had taken the direction of improvement of plant, and were clearly more due to the progress of the science of engineering than to that of chemistry.

But, on second and better thoughts, it became clear that the progress of chemical manufactures must be permanently based on chemistry, and aided by the advice of Sir H. Roscoe and other scientific chemists, we decided to found a society which should embrace all the Chemical Industries of this kingdom.

From time to time we continued to attract new adherents, and the Society was firmly constituted. On its council were placed men eminent in the scientific world as well as practical manufacturers, and the Society thus became a striking example of that union of science with practice which is the cause of the enormous progress of industry during the latter part of this century.

At our first general meeting the object of the Society and the lines upon which it might act were admirably laid down by our first President in his address, and by members of the Society in the various papers which were read.

It was pointed out that legislation on the control of the emission of noxious vapours or the pollution of rivers, or the amendment of the patents law, could be more wisely considered and guided by a Society such as ours, containing both scientific and practical chemists, than by any individual, however eminent, or by the individual action of each industry affected. The advantage of scientific and technical education, as illustrated by the progress of Germany in certain branches of chemical manufacture, was enforced by Sir H. Roscoe, and the importance of engineering devices and improved plant to the progress of the alkali manufacturer was shown by Mr. Maclear. It became apparent, however, that the annual meeting would not suffice for the discussion of these questions, and local sections were formed in the various centres of chemical industry, where papers are read and discussions take place during the year.

When any question of common interest comes to the front, it is discussed in each section, and by this means it is hoped that a common action may be elicited. The advantage of this was clearly shown in the discussion on the Pollution of Rivers. The subject was discussed in each section of the Society, and the principles upon which such legislation should be based, and how far purification of waste liquors was practicable, was clearly brought out in these discussions. As a consequence, when the River Purification Bill came before Parliament this year, Sir H. Roscoe was able to convince the President of the Local Government Board and the country of the impracticable character of that measure, and whenever legislation does take place, the opinion of this Society is certain to have considerable influence. The proposed adoption of uniform methods for estimating the commercial value of certain products, was discussed in several sections, but in this and in the special case of the assaying of copper ores, which we discussed in our Liverpool Section, the difference of opinion manifested, prevented any united action being taken. These discussions, however, will, I am persuaded, lead to more uniform methods being adopted, even if the time is not ripe for an international system.

I have briefly alluded to these subjects to show in how many ways the Society is of use, but the greatest work of the Society is the publication of the *Journal*, a publication which, in its way, is without a rival. When we consider how deficient we have been in publications of this character as compared with Germany, the Society has already conferred a great boon on the country, and will in future have a great and increasing influence on the progress and development of the chemical manufactures of the kingdom.

It has been the custom of my predecessors in the office of President to devote the greater portion

of their address to the history and progress of one special industry connected with the district in which the annual meeting is held. I am, however, in this unfortunate position, that the principal chemical industry with which I am specially identified, formed the subject of the eloquent address at Newcastle, of the late Mr. W. Weldon, whose loss this Society and the chemical world continue to deplore. I cannot emulate the eloquence of one who, in addition to his connection with the soda industry, was also a literary artist; nor can I pretend to the same intimate acquaintance with the various new processes, and the recent development of the manufacture of alkali.

I have thought, however, that it will not be uninteresting to the members of the Society, if in this city of Liverpool I endeavour to trace the history and development of the manufacture of alkali, including that of sulphuric acid, hydrochloric acid, and the production of copper, which are essentially connected the one with the other, and have been enormously increased, and improved by the introduction of the Leblanc process for making alkali from common salt by my father in 1823, within two miles of this building.

The economical success of the manufacture of artificial soda depends on the cheapness of the raw materials, and the perfection of the chemical and mechanical operations by means of which the final result is obtained.

The neighbourhood of Liverpool, in close proximity to extensive coal fields and salt deposits, and with a port in direct communication with the countries whence are derived the raw materials—sulphur, pyrites, and nitrate of soda—was well fitted to be the cradle of the manufacture, and notwithstanding the rivalry of Newcastle and Glasgow, still retains its pre-eminence. When we consider that, with the exception of sulphur, the prices of the several raw materials are not materially different from what they were 50 years ago, great improvements must have been made in the chemical operations to enable the manufacturer to sell soda ash at present prices, even taking into consideration the aid afforded by the increased consumption of the chlorine products.

The first chemical operation in an alkali works is the production of sulphuric acid. In or about the year 1823 the cost of producing this acid was, as far as I have been able to ascertain, about £3 10s. per ton of acid 140° Tw.; at the present time the cost is about 25 or 20 shillings per ton.

I shall now review briefly the means by which this economy of production has been obtained.

Attempts have often been made to supersede the costly leaden chambers by more economical structures, without success, but improvements have been made in the mode of construction of the plant, and a cheaper source of sulphur has been found in the cupreous pyrites of Spain and Portugal. The actual process followed is essentially the same as that first applied by Dr. Roebuck, in 1746, converting the sulphur into sulphurous acid at the expense of the oxygen of the air, and by the intervention of a nitrous compound for a further oxidation to sulphuric acid. The most important improvements have been the substitution of pyrites for sulphur, and the economy of nitrate of soda and fuel by means of the Gay Lussac absorbing column and the Glover Tower. Mons. Scheurer Kestner in a recent publication asserts that the first successful use of pyrites to Mons. Perrel, in 1833, but long before this date pyrites, obtained from his mines in Anglesea, was used in Liverpool by Mr. Hill. It was, however, the suicidal policy of the King of Naples in granting a monopoly of

the trade in Sicilian sulphur to a French firm, which raised the price of sulphur from £5 or £6 per ton to £12 and £14 per ton, that roused the English manufacturers to seek a substitute, which they found in the Wicklow and Welsh pyrites, and it was in this neighbourhood it was first used on a large scale, for in the years 1839 and 1840 large quantities were burnt by my father at his works at Liverpool and Newton.

As some of the pyrites contained copper, the residue, after burning, was delivered to the Sutton Copper Co., at St. Helens, so the utilisation of the copper in the pyrites was attempted at its first introduction.

The use of Irish pyrites in place of sulphur was soon generally adopted by alkali makers in the Lancashire district, but sulphur still continued to be used on the Tyne and so late as in the year 1852 we find 7580 tons of sulphur consumed in that district, when none was used in Lancashire.

Many difficulties were met with in the use of pyrites, and when the price of sulphur fell to £5 per ton, it was a disputed point among alkali makers whether at that price it was not more economical than Irish pyrites at about 25s. per ton.

Sulphur could be readily burnt on an iron plate, and although the admission of the necessary quantity of air to support combustion without admitting at the same time an excess, presented some difficulties, this was comparatively easily regulated. With Irish pyrites, however, containing only about 32 per cent. of sulphur combined with iron, sufficient air had to be admitted not only to burn the sulphur, but also to oxidise the iron; and as a consequence, the constitution of the gases entering the chamber was very irregular, and much larger chamber space was required than was necessary when using sulphur.

Pyrites smalls presented another difficulty—shelf burners were not invented—and to facilitate their burning in an ordinary kiln, the smalls were mixed with clay and shaped into balls, and dried, but the combustion was usually imperfect, and from 5 to 10 per cent. of sulphur was left in the residue. I have already mentioned that some of the ore, and particularly the smalls, contained copper, and large quantities were burnt and afterwards treated for copper in the ordinary smelting furnace, so long as the copper contents were sufficient to render the operation remunerative. It was found, however, that the percentage of copper decreased, and much of the ore contained less than 1 per cent. of copper, which was not profitable to smelt, and the residues were thrown away and accumulated in large heaps, until in the year 1850 Mr. Gossage purchased for a nominal sum large quantities of these residues, and smelted them to a regulus both at Widnes and Newcastle. This regulus was sold to Messrs. Vivian & Sons, of Swansea, who at that time were able to pay a higher price than the copper contents alone would have warranted, on account of the silver therein contained, and which they extracted, I believe by the Augustin or Zierooegel process.

In the year 1859 pyrites from Spain and Portugal was first introduced into this country and burnt by alkali makers on a large scale. This pyrites, containing about 2½ to 3 per cent. of copper, was very suitable as a flux for smelting when mixed with other ore, and large quantities of the burnt ore were delivered to the copper works at St. Helens and Widnes, but the price obtained was not sufficient to materially reduce the price of the sulphur to the alkali manufacturer, as the quantity required as a flux with ores was limited, and the smelting of the residue by itself was unprofitable. The assay of copper ores by the Cornish assayers also militated very much against the general use of these ores, for

the production of sulphuric acid and non-cupreous ores of very fine quality testing about 40 to 45 per cent. were also introduced from Norway and Belgium, and these for a time competed successfully with the cupreous ores. I have not been able to obtain full statistics of the imports of foreign pyrites into the United Kingdom for the first ten years of their introduction, but the imports into the Mersey rose from 26,641 tons in 1859 to 133,864 in 1869. From that year the statistics are fuller, and Tables A and B will show the course of the trade.

In the year 1871 about 100,000 tons of the non-cupreous ore also was imported and consumed, but this gradually fell off as the extraction of copper increased. The great aim of the alkali manufacturer was to obtain the sulphur at the lowest possible price; but as I have before explained, the intricacies of the copper assay left him very much in the hands of the copper smelter, and the increased consumption of the ore gradually raised the price directly or indirectly until a combination of alkali makers acquired the Tharsis mines, together with Mr. Henderson's patent rights for the extraction of copper by calcination of the ore with common salt, and subsequent lixiviation of the calcined mass and precipitation of the copper by iron. The calcination was conducted in a close furnace, the HCl evolved, and the copper volatilised being condensed in the usual manner, and used for the lixiviation of the roasted ores. The process itself does not differ materially from Mr. Longmaid's, to which I shall refer later, but to Mr. Henderson is due the credit of discovering the suitability of this method for the treatment of the burnt Spanish ores in the market.

The process when first applied to the burnt Irish ores was not very remunerative, but with the burnt ore from Spanish and Portuguese ores the oxide of iron or purple ore left after lixiviation found a ready sale, and practically paid for the cost of extraction, leaving the difference between the quantity of copper yielded by the wet and dry assay as profit on the operation. By the introduction of this wet extraction process, the sulphuric acid manufacturer was freed from depending on the copper smelter, and the price of sulphur was reduced owing to the competition of the various pyrites companies.

This lasted till 1879, when the three large companies combined to fix the price of pyrites, and since that time until the combination was broken up by the Tharsis Company in 1885, with a view to enable the alkali manufacturers to compete with the ammonia soda process, the price of sulphur has always been a source of great anxiety. The course of the price of sulphur to the alkali manufacturer may be seen from Tables C and D.

The effect of these improvements in copper extraction has been to bind more closely together the manufacturer of alkali with the production of copper, sometimes by the same firm, or, as in the case of the Tharsis Co., by the shares in the copper company being largely held by alkali makers. I shall, later on, trace the progress and improvement in the copper extraction, and now return to the use of pyrites in the production of sulphuric acid. The chemical process in the sulphuric acid chambers was by no means as regular as could be desired, even when burning sulphur; but with pyrites, for the reasons already given, the irregularity was still greater, and as a consequence the production of sulphuric acid showed a result considerably below what was theoretically possible, and the quantity of pyrites and nitre used to produce a ton of sulphuric acid differed in various works from 10 to 20 per cent. In his letters on Chemistry which appeared in 1851, if not in his earlier letters, Liebig says, speaking of the

TABLE A.
IMPORTS OF PYRITES INTO THE MERSEY FROM 1859 TO 1885 INCLUSIVE.

1859.	1860.	1861.	1862.	1863.	1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	1872.
26,611	42,264	39,248	41,788	71,752	66,245	68,230	91,188	108,430	77,999	133,864	115,705	152,138	192,420

TABLE B.
IMPORTS OF PYRITES INTO THE UNITED KINGDOM (IN ADDITION TO ABOVE).

	1870.	1871.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.
Newcastle-on-Tyne	130,686	113,464	140,221	146,496	111,068	117,488	120,869	189,134	139,524	169,638	219,089	173,978	125,546	111,106	101,039	—
London	16,758	28,229	28,485	—	—	—	38,983	41,062	35,182	21,690	22,798	34,117	49,912	58,116	48,990	—
Bristol	10,810	11,107	11,136	—	—	—	—	—	—	—	—	11,136	13,040	15,136	8,776	—
Hull	10,207	19,406	27,459	—	—	—	21,237	25,883	21,364	16,587	—	22,017	27,912	20,173	21,312	—
Glasgow	23,006	26,798	21,056	—	—	—	19,608	24,731	20,096	16,481	28,295	20,103	25,529	30,250	20,268	—
Other Ports	74,310	100,700	21,750	176,192	174,637	207,555	136,898	158,880	138,016	76,375	107,539	76,861	127,029	119,170	137,338	—
Totals	265,897	302,404	253,167	322,688	318,765	325,513	337,600	439,690	355,112	393,780	377,724	338,215	368,929	353,551	337,723	—
Totals including the Mersey ..	411,512	451,542*	517,626†	520,347	498,729	515,428	501,732	679,312	579,261	181,392	658,047	512,378	627,700	601,288	563,073	651,521

* In 1871 about 100,000 tons of above were non-cupreous.

† In 1872 about 95,000 tons of above were non-cupreous.

TABLE C.

PRICES OBTAINED IN THE LIVERPOOL DISTRICT FOR PYRITES FROM 1st JANUARY, 1861.
WHEN SOLD FOR SULPHUR ONLY.

	Price per unit.	Allowance per unit of Sulphur.	Net Cost to Alkali Works per unit of Sulphur.	
	d.	d.	d.	
1861	10'85	—	10'85	—
1862	9'625	—	9'625	—
1863	8	—	8	—
1865	9	—	9	—
January, 1866	9½	—	9½	Tharsis Company formed.
March, 1866	11'02	—	11'02	—
January, 1868	10'01	—	10'01	—
June, 1868	9½	—	9½	—
October, 1868	8	—	8	—
January, 1869	7	—	7	—
June, 1869	8	—	8	—
1870	7	½	6½	1d. allowance was made this year on some small parcels charged by Masons at 7d.
1871	8	½	7½	—
1872	9	1½	7½	1872. Small lot of Pyrites sold also at 10d.
1873				
1876	6	½	5½	First appearance of Rio Tinto Co.
1877	5	½	4½	—
1878				
January, 1879	6	½	5½	1879. Sl. Combination of Pyrites Co.'s.
to Decemb'r, 1881				
1885	4½	1d. to 1½d.	3d. to 3½d.	Combination ceased.
to 1887				

TABLE D.

WHEN SOLD FOR BOTH VALUES.				WHEN SOLD FOR BOTH VALUES.			
From	Price per 21cwt., allowing moisture and draft.			From	Price per 21cwt., allowing moisture and draft.		
Jan. 1, 1861..	60/- for Sulphur and 2½ Copper.	Excess		Jan. 1, 1873..	38/9½ (9½d. per unit) for Sulphur and Swansea price. R.C. 45/- for Copper; and 10/- (9½d. per unit) for Sulphur and Swansea price. R.C. 15/- for Copper		
Sept. 1, 1861..	55/- for Sulphur and 2½ Copper.	Excess					
Dec. 1, 1863..	46/6 for Sulphur and 2½ Copper.	Excess		July 1, 1871..	36/9 (9d. per unit) for Sulphur and Swansea price. R.C. 45/- for Copper		
Jan. 1, 1865..	50/- for Sulphur and 2½ Copper.	Excess		Jan. 1, 1875..	33/8½ (8½d. per unit) for Sulphur and Swansea price. R.C. 45/- for Copper		
Oct. 1, 1865..	52/6 for Sulphur and 2½ Copper.	Excess		Jan. 1, 1876..	22/5½ (5½d. per unit) for Sulphur and Swansea price. R.C. 15/- for Copper		
Jan. 1, 1866..	55/- for Sulphur and 2½ Copper.	Excess		Jan. 1, 1877..	20/5 (5d. per unit) for Sulphur and Swansea price. R.C. 15/- for Copper		
Mar. 1, 1866..	65/- for Sulphur and 2½ Copper.	Excess		Jan. 1, 1879..	24/6 (6d. per unit) for Sulphur and Swansea price. R.C. 41/- for Copper		
Oct. 1, 1868..	28/7 (7d. per unit) for Sulphur and Swansea price. R.C. 45/- for Copper			Jan. 1, 1880..	24/6 (6d. per unit) for Sulphur and Swansea price. R.C. 40/- and 37/6 for Copper		
Jan. 1, 1869..	21/6 (6d. per unit) for Sulphur and Swansea price. R.C. 15/- for Copper			Jan. 1, 1881..	24/6 (6d. per unit) for Sulphur and Swansea price. R.C. 40/- and 37/6 for Copper		
June 20, 1869.	28/7 (7d. per unit) for Sulphur and Swansea price. R.C. 45/- for Copper			Jan. 1, 1882..	24/6 (6d. per unit) for Sulphur and Swansea price. R.C. 40/- for Copper		
Mar. 1, 1870..	24/6 (6d. per unit) for Sulphur and Swansea price. R.C. 45/- for Copper			Jan. 1, 1883..	24/6 (6d. per unit) for Sulphur and Swansea price. R.C. 40/- for Copper		
Jan. 1, 1871..	28/7 (7d. per unit) for Sulphur and Swansea price. R.C. 45/- for Copper			Jan. 1, 1884..	24/6 (6d. per unit) for Sulphur and Swansea price. R.C. 40/- for Copper		
Jan. 1, 1872..	32/8 (8d. per unit) for Sulphur and Swansea price. R.C. 45/- for Copper; and 36/9 (9d. per unit) for Sulphur and Swansea price. R.C. 45/- for Copper			1885, '86, & '87	13/1½ (4½d. per unit) for Sulphur and Swansea price. R.C. 38/- based on Chili Bars		

process of making sulphuric acid:—"As regards the process and the apparatus, this manufacture has reached its acmé, scarcely is either susceptible of improvement," but to those practically acquainted with the manufacture and with the immense improvement since that date, this statement must appear extravagant. Liebig was, no doubt, misled by reports of very careful working with sulphur and enormous chamber space.

The introduction of Gay-Lussac's system for the absorption of the nitrous fumes escaping from the chambers was the first great improvement in the conduct of the chemical operation. In this system the exit gases of the chambers pass up a tower filled with coke, down which percolates a stream of concentrated sulphuric acid, by means of which the nitrous gases are absorbed. By diluting this nitrous vitriol and heating with steam, the nitrous gas is returned to the chambers. This system was first adopted at the St. Gobain Works in France in the year 1842, with a saving of fifty per cent. of the nitrate of soda used; but notwithstanding this saving, after it had been introduced into several works in this neighbourhood, it was subsequently abandoned, partly on account of the great wear and tear on the apparatus employed, and partly because when working with Irish pyrites the exit gases were so diluted by air as to render the absorption comparatively difficult. The use of the richer Spanish ores since 1859, which rendered the composition of the gases leaving the chambers more regular, and Mr. Glover's improvements in the concentration and denitration of the sulphuric acid, brought about the general adoption of the Gay-Lussac absorbing column. It is clear that Gay-Lussac's invention was incomplete, and at an early date (about the year 1843) experiments were made at our works in Liverpool to concentrate the sulphuric acid by means of the sulphurous gas from the pyrites kilns; but the tower through which the gas passed, and which was filled with coke, took fire owing to the carelessness on the part of the workmen, and the attempt was abandoned. To Mr. Glover is due the merit of having successfully constructed an apparatus, by means of which the nitrous vitriol is denitrated and the sulphuric acid sufficiently concentrated for use in absorbing the nitrous gas in the Gay-Lussac column. With this invention the apparatus for producing sulphuric acid in leaden chambers is complete, but the present perfection of working has only been attained by the application of trained chemists to the study of the process, and the introduction of apparatus for the accurate but rapid estimation of the constituents of the gases entering and leaving the chambers. Much of this work has been done in Germany, and by the investigations of Winkler, Weber, Schwarzenberg and others, we have a much clearer idea of the reactions which take place in the chambers and absorbing columns than formerly. Dr. Hurter's paper on the dynamic theory of the manufacture of sulphuric acid, read before the Liverpool Section of this Society in 1882, seems finally to have placed the operation on a thoroughly scientific footing. Orsat's apparatus for gas analysis, and the nitrometer, enable the manufacturer to control the working of his chambers in a very different way to that in use in the best works thirty years ago, where the colour of escaping gas on coming in contact with the air, or the use of the nose, served as an indication of how the reaction was proceeding. For the past ten years no important improvement in the manufacture has taken place, nor can we expect any, since with good apparatus the loss of sulphur escaping is reduced below one per cent., with a consumption of nitre of less than two per cent. on the sulphur burnt. In order to treat the large quantities

of burnt pyrites furnished by the alkali manufacturers, large extracting works were erected in this neighbourhood and on the Tyne, and the quantity of copper extracted greatly exceeds the aggregate production from the copper mines of the United Kingdom, as is apparent from the annexed table, extracted from the mineral statistics:—

Aggregate Productions from the Copper Mines of the United Kingdom.		Copper Pyrites imported and treated here, and Precipitate obtained.	
	ORE.		
	Tons.	Tons.	Tons.
1874	—	—	450,000
1875	71,528	1,323	480,000
1876	79,252	1,691	379,269
1877	73,141	1,186	425,000
1878	56,091	3,952	577,719
1879	51,032	3,462	385,871
1880	52,128	3,662	415,567
1881	52,556	3,875	496,737
1882	Inspector's Returns, 53,237	Inspector's Returns, 3,161	434,427
1883	46,819	2,620	601,288
1884	42,149	3,350	416,412

It had long been known that the copper precipitate produced from the Spanish and Portuguese ores contained both silver and gold, but as the amount of silver present in the burnt ore was exceedingly small (and even the whole of this small quantity is not obtained in solution), a simple and expeditious method was necessary, if its extraction could be made remunerative. In the year 1870, Mr. Claudet introduced his beautiful process at the works of the Widnes Metal Co., and since then about 2½ millions of ounces of silver, and 11,965 ounces of gold have been extracted from the burnt pyrites, as is shown by the following table, for which I am indebted to Mr. Claudet:—

	Silver.	Gold.
	Ounces.	Ounces.
1870 to 1879	492,727	1,925'6
1880	206,981	1,017'6
1881	258,463	1,489'8
1882	377,189	1,518'9
1883	356,349	1,983'2
To January 31st, 1884	1,691,709	7,965'1
Estimated 1884 and 1885	800,000	4,000
	2,491,709	11,965

This process is based on the precipitation of the silver from the copper liquors by means of a soluble iodide, the precipitate consists of silver iodide together with lead sulphate and chloride and sub-salts of copper. These last are removed by washing with diluted HCl, and the precipitate is then decomposed by metallic zinc, which completely reduces the silver iodide, and the resulting zinc iodide is used over again to precipitate further quantities of silver.

Where the pyrites residues are thus treated, it will be seen that all the constituents of the pyrites are practically made available: the sulphur for the production of sulphuric acid, and the iron, copper, silver, and gold, in the extracting works.

Unfortunately all the salt used in the calcination process, amounting to over 20,000 tons per annum, is at present lost, and is run away as sodium sulphate in the waste liquors.

This drainage from the extracting works, coming in contact with the chloride of calcium, the waste liquor from the Weldon process in alkali works, deposits large quantities of gypsum obstructing the drainage, which gave rise to a long and expensive lawsuit in the Widnes district.

To avoid this nuisance, the liquors were for a time evaporated and calcined, and the sulphate of soda, together with a small quantity of ferric oxide, were obtained in a marketable form, but the high price of fuel rendered all these processes unremunerative.

Sulphate of Sodium.

The second operation in the manufacture of soda by the Leblanc process is the decomposition of common salt by means of sulphuric acid, and the consequent production of sulphate of sodium and hydrochloric acid. As the chemical reaction is a very simple one, and had been carried out for the production of hydrochloric acid long before the introduction of the Leblanc process, the improvements that have been made have necessarily taken the form of improved apparatus. Where the primary object was the production of hydrochloric acid, the apparatus employed was either glass retorts or iron pots; but when the sulphate of sodium became the main object of the operation, furnaces were employed, either with or without a lead lining.

The operation is now conducted in two stages. The first, decomposition with the formation of bisulphate of sodium, takes place at a low temperature in an iron or lead pan, yielding strong hydrochloric acid, which can be easily condensed, and when the hydrochloric acid was of little value, the decomposition was completed, forming neutral sulphate of sodium, in an open reverberatory furnace, the liberated hydrochloric acid passing off together with the products of combustion. Where more hydrochloric acid was required, either for sale or for use, than was yielded by the pan, a close or muffle furnace was substituted for the second stage, or the roasting of the sulphate.

By the use of these improved sulphate furnaces, together with condensers or towers filled with coke, through which the gas passes, meeting a stream of water (a plan for which Mr. Gossage obtained a patent so early as 1836), the sulphate can be manufactured of excellent quality, and without causing injury to the neighbourhood. The substitution of machinery for hand labour, first attempted by Mr. W. W. Pattinson in 1848, has been carried to perfection by Messrs. Jones & Walsh, Mr. Maclaur, and the Bede Co. Owing to the difficulty of obtaining strong hydrochloric acid, in the case of Messrs. Jones & Walsh and Maclaur's furnaces, most manufacturers find it convenient to use improved muffle furnaces worked by hand.

Mr. Gossage introduced his plan of condensing the hydrochloric acid in 1836, but a long time elapsed before it was generally adopted. The construction of plant for chemical purposes was then very imperfect and costly, and only those manufacturers who were possessed of sufficient capital were able to apply the improved system, notwithstanding the complaints of nuisance and the frequent litigation that ensued. The present generation can hardly form an idea of the intensity of feeling and prejudice aroused against

chemical and alkali works during the first forty years of their existence—*i.e.*, up to the passing of the Alkali Act in 1863.

Hardly an assizes passed without an action for nuisance or damage, and, as this litigation continued without absolute ruin to the manufacturer, the public believed the profits to be fabulous, and many people without chemical knowledge commenced to decompose salt, sometimes selling the salt-cake to soap-makers to be converted by them into black ash, or, as the demand for alkali continued to increase, converting the salt-cake themselves into soda ash. The effect was, that long after Mr. Gossage had solved the difficulty of condensing the large quantities of hydrochloric acid evolved, many works continued to manufacture without condensation, and those who expended money on condensing apparatus were only induced to use it in proportion as they found an outlet for the liquid hydrochloric acid.

How, at last, in the year 1863, the Alkali Act was passed, and good condensation was made compulsory, I have already described in my paper on Noxious Gases Legislation, read before the first meeting of the Society. In Lancashire, and more particularly in Liverpool and St. Helens, there was a considerable local demand for hydrochloric acid: but, as this acid was required in a comparatively concentrated form, a different mode of making the salt-cake was adopted to that which was found suitable on the Tyne, where the greater portion of the acid, after condensation, was run to waste. It was in Lancashire, therefore, that the pot was first separated from the furnace, and the close roaster introduced by Mr. J. C. Gamble.

With an increasing demand for alkali, much more acid was produced than could be easily disposed of, and the alkali manufacturer was gradually led to manufacture bleaching powder for the purpose of utilising his hydrochloric acid. When bleaching powder or dry chloride of lime was first made by Mr. C. Tennant, of St. Rollox, the chlorine was produced from a mixture of salt manganese and sulphuric acid; but when, by the manufacture of sulphate of sodium, a large quantity of liquid acid was obtained of little value, it was used to produce the chlorine by the direct action of the hydrochloric acid on peroxide of manganese.

Much difficulty was encountered in constructing suitable apparatus for such a pungent and corrosive gas as chlorine, and many improvements were gradually introduced into the manufacture in the form of improved apparatus.

At an early date attention was called to the possibility of recovering the manganese which ran to waste in the still liquor; but Mr. Dunlop was the first to effect this regeneration in a practical manner, by a very ingenious process, which he introduced in Messrs. Tennant's works at Glasgow. In this process the waste manganese liquors were neutralised by lime, and the neutralised liquor converted into carbonate of manganese by treatment with carbonate of calcium under pressure of $2\frac{1}{2}$ atmospheres. The resulting carbonate of manganese was then converted into the peroxide by heating in a current of air. The plant required was very costly in proportion to the quantity regenerated, and this, together with the cost of the fuel employed, prevented the extension of the process to other works.

With this exception none of the various processes suggested to recover the manganese were successful, and the preparation of chlorine continued without any great change, till Mr. Weldon carried to perfection his well-known method of recovery, in Mr. Gamble's Works at St. Helens. This process has been so often described that it is unnecessary to further particularise it here. It was early adopted in

the Widnes and St. Helens district, and, as the demand for bleaching powder increased, spread rapidly. The economic effect of the process was very great, since the alkali manufacturer was enabled to produce chlorine and its products at a marvellously small cost, so long as the price of the soda left a small profit.

With a decrease in the price of bleaching powder came a rapid increase of consumption, since the paper manufacturers, freed from the Excise Duty on paper in 1861, turned their attention to other fibres, requiring large quantities of bleach, such as straw, esparto, wood, etc., as a substitute for rags, which were daily becoming scarcer. There was, simultaneously, a large increase of the exports of bleaching powder from this country to the Continent, as it was manufactured so much cheaper by the new process before it had been generally adopted in France and Germany.

The increase in the trade was greater in Lancashire than elsewhere, and for the next ten years there was a marvellous increase in the population of Widnes and St. Helens, owing to the erection of new works.

Another use for hydrochloric acid was found in the production of potassium chlorate, first manufactured on a comparatively large scale by Mr. Balmain and Mr. E. A. Parnell, at St. Helens in 1847, and by Mr. Gamble in 1848.

The process employed was the saturation of milk of lime by an excess of chlorine, which produces a pinkish solution of chlorate of calcium and chloride of calcium, in the proportion of about 1:5.5, and the subsequent decomposition of the chlorate of calcium by heating with chloride of potassium. The chlorate of potassium is then separated from the calcium chloride by crystallisation. This process was first proposed by Liebig, but it is not certain whether he was aware of the necessity of perfectly saturating the lime with chlorine before applying heat. This fact seems to have been known to Mr. Parnell, who proved by experiment that when even a small quantity of lime was present, oxygen is disengaged largely on heating, with a proportionate loss of chlorate in the liquors.

The demand for chlorate of potash being comparatively restricted, the manufacture could not be largely increased without an undue fall in the price, and for many years the quantity made was exceedingly small. The price at first was 2s. 4d. per lb., but with an increased production the price fell quickly, and in 1852 was 10d. per lb., at which it left little or no profit, until by the introduction of the Weldon manganese recovery process the cost of production was materially lessened. Of late years, with a largely-increased consumption for match-making, the manufacture has increased considerably, particularly in Widnes and St. Helens, but as the consumption in the colour manufacture fell off, a large stock accumulated, and it was almost unsaleable even at 5d. per lb.

I must not leave this portion of the subject without alluding to the beautiful process for the production of chlorine invented by Mr. Deacon, another Widnes manufacturer, but which, for reasons which it would take me too long to explain fully, has not been generally adopted. I shall have to recur again to the effects of these improvements in the utilisation of the chlorine of the salt, when I come to speak of the ammonia soda process.

Before proceeding to the third operation in the Leblanc alkali process, I must call attention to some interesting attempts that have been made in this district to supersede sulphuric acid chambers, and the manufacture of sulphuric acid, as a preliminary to the conversion of common salt into sulphate of sodium.

The first in point of time is that of Mr. Longmand, which consisted in roasting iron pyrites, containing small quantities of copper, with salt, in a reverberatory furnace. The result was the production of sulphate of sodium and ferric oxide, with the evolution of hydrochloric acid chlorine and some chloride of iron and copper. From the calcined mass the sulphate of sodium was extracted by lixiviation, and the residue worked for copper and silver. The chlorine evolved was used to make bleaching powder, but the difficulties which had to be overcome in utilising the chlorine on account of its dilution, and the loss of sulphur in the calcination, rendered the process less remunerative than might have been expected. It was worked at the Patent Alkali Company's Works at St. Helens, from 1846 to about 1856, when it was abandoned. The process, however, in another form—viz., treating the burnt instead of the unburnt ore—has, as I have already shown, been more successful, and the sulphate of sodium, which now runs to waste, may be utilised, if the expense of evaporating the liquors is not too great.

Another process, perfected by Mr. Hargreaves, and first carried out by him at Widnes, has been adopted by some manufacturers, and would have been more generally used if it had not been for the simultaneous improvement of the sulphuric acid manufacture by the introduction of the nitrate-saving apparatus, and the low price of nitrate of soda.

The process consists in the direct action of sulphurous acid and steam upon common salt, at a temperature of 800° to 900° F., yielding a very pure sulphate of sodium and hydrochloric acid, which is condensed in the usual manner. The process is in operation at three works in Widnes, decomposing about 25,000 tons of salt annually.

The next step in the conversion of sulphate of sodium into carbonate, is the making of black ash by fluxing the sulphate of sodium with carbonate of calcium and coal. This is the true Leblanc process, and so far as the chemical operation is concerned remains essentially the same as that practised by Leblanc himself. The theory of the operation is, however, not absolutely decided, even at the present day, and its obscurity led to numerous analyses of and investigations into the nature of black ash, and of the waste after lixiviation, that fill volumes of chemical literature. It is not necessary for me to refer more in detail to these investigations of Gossage, Meyer, Brown, Kynaston, Scheurer Kestner, Kolb, and Mactear, which are well known to all interested in the alkali manufacture, as the practical result has been confined to some slight alterations in the quantities of the materials used in the mixing, before the introduction of the charge to the furnace. The almost universal adoption of mechanical furnaces has brought about a general uniformity in the production, which with hand furnaces varied considerably in different works. When my father first commenced making black ash on the large scale, in 1823, the principal improvement he effected was in the quality of the black ash produced, since the small quantity then made in England and France contained only about 10 or 12 per cent. of alkali. From the first he produced black-ash testing by the then alkalimetric test, 24 per cent. of alkali, and in this form it was delivered to the soap makers, of which there were seven or eight in Liverpool itself, to be used in place of kelp. It was found, however, when this black ash was exported, it lost strength from exposure to the air, and to meet this difficulty the carbonate of soda was extracted by lixiviation, and the liquors calcined in a reverberatory furnace, producing the so-called white ash or soda ash. It is not necessary for me, nor would time allow, to refer at length to the numerous small improvements gradually introduced

into the manufacture since its commencement, but many were first introduced in this neighbourhood, such as the utilisation of the waste heat for evaporation, the systematic lixiviation of the black ash, the use of boat and fishing pans, the separation of the salts of monocarbonate of sodium from the caustic alkali or red liquor, and finally the manufacture of caustic soda itself.

These, and many other improvements, are due to Lancashire manufacturers, among whom I may mention Gossage, Gamble, Deacon, etc. In addition to these, the greatest improvement of all, the use of revolvers or mechanical furnaces, was also first introduced in this neighbourhood, in 1853, by G. Elliott and W. Russell, at the Patent Alkali Company's Works at St. Helens. This first revolver did not work satisfactorily, and it took a long time and numerous experiments on the part of Messrs. Stevenson & Williamson at Jarrow to overcome the difficulties encountered in the lixiviation of the metals, which were not porous enough; but now all these have been overcome, and the metals produced by the revolver are superior in every way to the best worked by hand.*

At an early period a difference in the mode of working on the Tyne, and in Lancashire, developed itself. On the Tyne the greater portion of the alkali produced took the form of carbonated ash and crystals of soda, but in Lancashire, where so much of the ash was used for bleaching and soap making, a caustic ash was produced, and as the sulphide and ferrocyanide of sodium it contained was found to be injurious for many purposes, much ingenuity and skill were employed to eliminate these from the liquors. In 1853 Mr. Gossage obtained a patent for purifying the black ash liquors by the oxidation of the sulphide of sodium, by passing them through a tower filled with coke, meeting a current of air, or if a carbonated ash was required by passing carbonic acid through the tower. This patent also included a process for the production of caustic soda, and at a later period (1857) he suggested removing the sulphide by means of hydrated ferric oxide, zinc, manganese, or other suitable metal. These suggestions all culminated in the separation of the carbonate of soda from the caustic soda in the liquors by the use of so-called fishing pans, where the salts, as they are deposited on evaporation, are withdrawn by perforated ladles, and the salts carried to a drainer.

The concentrated liquor is further evaporated with addition of nitrate of sodium, and is then run into settlers, where it deposits a further quantity of salts, and the red liquor is further concentrated in a cast-iron pot, and when strong enough to solidify is packed as cream or red liquor caustic soda. The nitrate of sodium reacts both on the sulphide and cyanides of sodium, but it was observed first, I believe, by Dr. Pauli, that by a further concentration when the heat approached redness, the destruction of the cyanides is complete, and graphite is formed proceeding from the carbon of the cyanide. When this, together with the aluminium silicate, is allowed to settle out, the caustic soda becomes colourless, and, when packed, perfectly white. The first red liquor caustic soda made on a large scale, was made by Mr. Gamble at St. Helens, under Mr. Gossage's patent, but much difficulty was experienced in the manufacture, and it was confined to a few firms in the Widnes and St. Helens district. As a market was found at good prices for this caustic soda, it occurred to some manufacturers to causticise the liquors with lime before evaporation, and Messrs. Roberts, Dale & Co., of Manchester, and

Messrs. Hutchinson & Co., of Widnes, erected a large plant for the manufacture of this so-called artificial caustic soda, to distinguish it from the red liquor caustic then in the market. Most of this good coloured or white caustic soda was made in this manner, but the cost was considerably greater than that of the red liquor caustic, and until the consumption increased very considerably it did not pay the manufacturer to incur this expense. In the exhibition of 1862, there were exhibited samples of this article by several manufacturers, and in 1866, as is seen by the statistics of that year, a large quantity (11,213 tons) was manufactured in Lancashire, and 3720 tons on the Tyne. With the extended consumption of caustic soda for use in the refining of petroleum, the manufacture of soap and paper making, and in the manufacture of aniline colours, this industry has taken an enormous development, and in 1885, 140,795 tons were manufactured in Lancashire, and 4159 tons on the Tyne.

After the black ash has been lixiviated, and the soda converted into either soda ash or crystals or caustic soda for sale, there remains the alkali waste, containing nearly all the sulphur consumed in the manufacture, and this waste, when not removed out to sea, as on the Tyne, accumulates in large heaps round the works, and unless properly treated, infects the air with the unpleasant odour of sulphuretted hydrogen. Since the passing of the Alkali Act of 1863, it may safely be asserted that nearly all the complaints of nuisance from alkali works are due, not to hydrochloric acid, but to the sulphuretted hydrogen given off by the drainage from the waste heaps. It has not been for the want of either enterprise or science on the part of the manufacturers that this source of nuisance continues to exist. Means are well known which will render the waste comparatively innocuous, and it is satisfactory to know that the method now recommended by the Alkali Inspector for the prevention of the nuisance from waste heaps, emanated from the manufacturers themselves. It is, however, to be regretted that hitherto no process for recovering all the sulphur in the waste has been successful from a pecuniary point of view.

A small quantity is extracted by Mr. Mond's process, but Mr. Gossage's original scheme for decomposing the sulphide of calcium by carbonic acid, and Messrs. Schaffner and Helbig's plan for decomposing the waste by magnesium chloride, promised sufficiently well to induce my father, in 1839, and Messrs. Chance Bros. in 1882, to spend large sums of money in attempting to work them practically.

The fall in the price of sulphur, and the increasing value of hydrochloric acid, owing to the ammonia soda process, have entirely changed the commercial conditions, so that unless Messrs. Parnell and Simpson's process for uniting the Leblanc with the ammonia soda process (to which I shall allude later on) succeeds, I see little prospect of the recovery of the sulphur in future.

I have now traced very rapidly the rise and progress of the Leblanc alkali industry in this district, from 1823 to 1878, a period slightly exceeding half a century, and it is desirable at this stage to review the position of the trade, and to mark the change which the process has wrought in the prices of alkali and bleaching powder, the two forms in which the chlorine and sodium of the salt is made available for industrial purposes. I have selected the year 1878 for comparison, as from that date forward the competing ammonia soda process began to influence the price of alkali, and the whole position of the trade changed. I have also added the prices of this year, showing the influence exercised by the competition of the ammonia soda. (See Table E.)

* The extent of this improvement may be gauged if we consider that in a modern revolver of large dimensions, as much salt cake can be decomposed in a given time as in ten hand furnaces requiring 40 men, and the decomposition itself is from 10 to 15 per cent. more efficient.

The prices of the raw material have not varied nearly so much as those of the manufactured products, as will be seen from Tables E and F. The cost of the sulphur used has been reduced by the substitution of pyrites, but to-day the price of sulphur itself is the same as in 1830—viz., £5 per ton. For the prices of manufactured goods and of the raw

demand, to 1d. per degree. Before the introduction of revolvers and the more modern improvements a price of 1½d. per degree, or £7 per ton, for 48 per cent., barely covered the cost of production.

In 1852 we have the first estimate of the production of alkali for the United Kingdom, prepared by Mr. Allhusen; and, in 1861, according to Messrs. Schunck,

TABLE E.

COMPARATIVE PRICES OF MANUFACTURED ARTICLES AT VARIOUS DATES.

	Liverpool, 1827—1830.	Liverpool, 1839—1840.	Liverpool, 1878.	Liverpool, 1886, After Ammonia Process.
Black Ash	£7 to £10 for 20°	(1835) £4 10s.	—	—
Soda Ash	£16 10s.	£15 per ton.	1½d. to 1¾d. ½ per cwt. or £5 10s. to £6 per ton.	1d. to 1½d. ½ per cwt. or £4 to £4 10s. per ton.
Salt Cake	£7 10s.	£6 10s. „ „	£2 (unpacked).	25s. per ton.
Nitre Cake.....	£12 5s. from Nitrate of Potash.	—	—	17s. „ „
Soda Crystals	£18 10s.	£11 „ „	£3 12 6	£2 15s. „ „
Caustic Soda, 70 per cent.....	—	—	£12 10s.	£8 5s. „ „
„ „ 60 per cent.....	—	—	£10 5s.	£7 5s. „ „
Bleaching Powder	—	£19 per ton.	£5	£5 17s. 6d. per ton.
*Concentrated Vitriol	2d. per lb.	1½d. per lb.	1½d. per lb., or	4½d. per ton.
*Muriatic Acid	2d. „ „	1d. „ „	5s. to 10s. per ton.	5s. to 10s. per ton.
*Nitrous Acid	6½d. „ „	—	—	5d.
Brown Vitriol	1½d. to 1d. per lb.	—	£3 per ton.	£2 per ton.

* When the acids are sold per lb., the discounts vary according to circumstances.

TABLE F.

COMPARATIVE PRICES OF RAW MATERIALS.

	Liverpool, 1827—1830.	1839—1840.	Widnes, 1878.	Widnes, 1886.
Sulphur	£5 10s.	£11 10s. (monopoly).	£6 15s.	£5.
Salt	6s. to 8s.	9s.	8s. 9d.	8s.
Limestone	—	1s. 6d.	5s. 6d.	4s. 6d.
Lime	13s. 1d.	7s. 6d.	11s.	11s. 6d.
Nitrate of Soda	—	£16 10s.	£14.	£9 10s.
Nitrate of Potash	£30.	—	—	—
Slack	(1831) 6s. and 6s. 9d.	At Liverpool, 1839, 5s. ; 2s. 6d. per ton at Newton in 1840.	5s.	1s. 6d.

materials at the earlier period, I have taken the prices according to my father's books during the years 1827—1830, when the consumption of black ash had superseded that of kelp, in Liverpool. On referring to the table, it will be seen that black ash was sold in 1827 at 10s. for 20 per cent., or 6d. per degree. In 1828 the price had been reduced to 7s. for 20 per cent. In 1830 the first large sales of white ash were made at about £16 10s. per ton, but this ash seems to have been only about 35 per cent., and may have been made partly from the mother-liquor of crystals. In 1835 the same price seems to have been paid, but the strength now was 48 to 50 per cent., and from that date forward the strength 48 per cent. was taken as the standard, and the ash sold according to degree at prices varying from 3d. to 4d., and this price has been gradually reduced, with fluctuations according to the

Smith & Roscoe, the production in Lancashire was as mentioned below :—

	1852. Manufactured in the United Kingdom.	1852. In Lancashire.	1861. In Lancashire.
Alkali	71,193 tons.	26,313 tons.	93,630 tons.
Soda Crystals	61,011 „	3,500 „	8,810 „
Bicarbonate of Soda	5,726 „	1,200 „	11,700 „
Bleaching Powder	13,100 „	1,250 „	8,060 „

But all these estimates were very imperfect, and it is not until 1866 that we have a trustworthy record

of the trade, which is shown in the following table :—

	Lancashire Branch.	Tyne Branch.	Total.
Soda Crystals	24,978	86,000	110,978
Soda Ash and Refined Alkali....	87,314	74,000	161,314
Caustic Soda	11,213	3,720	14,933
Bicarbonate of Soda	6,457	11,000	17,457
Sulphate of Soda	32,137	2,400	34,537
Bleaching Powder	20,006	27,000	47,006
Bleach Liquor	5,871	—	5,871
Oil of Vitriol (for sale)	18,592	9,000	27,592
Muriatic Acid (for sale)	13,819	700	14,519
Salt decomposed ..	194,000	157,000	351,000

In 1877 the Alkali Association commenced their annual statistics, and in the report of 1878 the most notable feature is the large increase in the production of caustic soda, and bleaching powder, more especially in Lancashire as compared with the Tyne. In 1861 the manufacture of caustic soda in Lancashire is estimated at 4680 tons, in 1878 the total for the United Kingdom was over 96,000 tons, of which 94,000 tons were made in Lancashire, and this is important in connection with the competition from alkali produced by the ammonia process.

STATISTICS OF ALKALI TRADE, 1878, AS ISSUED BY THE ALKALI MANUFACTURERS' ASSOCIATION.

	West District. Lancashire, Scotland, etc.	East District. Tyne.	Total Tons.
Salt decomposed ..	384,958*	183,584	568,542
Alkali equal to 48°	120,939	87,053	207,992
Soda Crystals	47,697	123,175	170,872
Caustic equal to 60°	82,585†	2,027	84,612
Bleaching Powder..	77,100	27,944	105,044
Bicarbonate of Soda	4,703	7,053	11,756
	717,982	430,836	1,148,818

Although I have been able to give the prices of the raw materials before 1860, it is impossible at the present day to estimate the cost of producing alkali before that date with any approach to accuracy; and as the wages paid and wear and tear and general charges vary in different works, it is useless making comparisons, even at the present time. In 1860, for the purpose of fixing the duties under the French Treaty, Mr. Allhusen and I endeavoured to arrive at the cost of production in the two countries, and found a great difference between the cost on the Tyne and in Lancashire; but in order to show the effect of the improvement in the manufacture, and the use of Spanish instead of Irish pyrites

has had on the cost of soda-ash, the following comparison of the cost of the raw materials to produce a ton of 48 per cent. ash in Lancashire in 1861 and to-day, after a lapse of twenty-five years, is interesting. For 1861 I have taken Mr. Gossage's figures :—

	1861.		1886.
1½ tons Pyrites (Irish)	£1 15 0	13½ cwt. Spanish Pyrites, 14° (Sulphur value)	£0 9 3
1 cwt. Nitrate of Soda	0 12 0	23 lb. at 10°	0 2 0
1½ tons Salt	0 10 0	25 cwt. at 8°	0 10 0
1½ .. Limestone ..	0 10 0	26 .. at 5°	0 6 6
3½ .. Fuel	1 1 0	2½ tons at 46°	0 12 6
	£4 8 0		£2 0 3

It is thus seen that, principally by the improvements in the sulphuric acid process, the cost of the raw materials has been reduced over 50 per cent. To this saving must be added the saving in labour by the use of machinery, and the reduction of wear and tear by improved apparatus; but, notwithstanding these improvements, as the cost of production by the ammonia process is very considerably less, the Leblanc alkali maker cannot continue to work at a profit, unless he is able to utilise the chlorine of the salt to a greater extent and more economically than the ammonia-soda maker. As the consumption of alkali in the form of soda-ash is limited, if ammonia-soda works continue to increase, part of the alkali produced by them must be converted into other forms, such as bicarbonate, crystals, and caustic soda; but as the Leblanc alkali maker can causticise his liquors cheaper than the ammonia-soda maker, the tendency will be for the Leblanc maker to manufacture caustic soda in the place of soda-ash. This has already taken place to a considerable extent, as the manufacture of caustic soda has increased from 96,000 tons in 1878 to 145,000 tons in 1885.

The problem before the Leblanc maker is a very difficult one, for he not only has to face the competition of the ammonia-soda maker in the price he obtains for his alkali, but if he increases the quantity of bleaching powder made and the consumption remains the same, the price of this product must also fall. A satisfactory position of the trade can only then be approached when the bleaching powder and other chlorine products together are the equivalent of the quantity of salt decomposed, and such a price is obtained for the chlorine as will compensate the Leblanc maker for his loss on the alkali produced. I have already pointed out how the manufacturer of alkali was forced to condense the hydrochloric acid produced, and indicated the various modes in which he made use of that acid. As by far the larger quantity of the hydrochloric acid produced is used for the manufacture of bleaching powder, Table G is interesting.

It will be seen that the production of bleaching powder has been stationary for the last five years, since it has been regulated by the manufacturers, and as the stocks are about the same, it is clear the consumption has been stationary also. When we further consider that one ton of bleach can at present be made by the consumption of two-and-a-half tons of salt, and that by improved processes the quantity of salt required will be still further reduced, we must look forward to a still further curtailment of the decomposition of salt by sulphuric acid. It is true, there are other uses for hydrochloric acid than the manufacture of bleaching powder, but these do not seem to increase, nor are they likely to do so. As

* Of this, 16,230 tons were decomposed by the ammonia process, producing a corresponding amount of alkali.

† In addition to this there were made in the Liverpool district about 12,000 tons caustic soda more than returned to the Association.

the price of hydrochloric acid is necessarily higher than it was, it may be superseded in some directions by sulphuric acid, which is much lower than formerly. It has been estimated that during the year 1884 hydrochloric acid was utilised for other purposes than the making of bleaching powder to the equivalent of 170,000 tons of salt, leaving 408,874 for the manufacture of bleach; but as the quantity of bleach produced, owing to the restriction, was only 128,651 tons, it is evident the acid from 87,247 tons of salt was not utilised. During that year the price of salt-cake left a small profit to the Leblanc manufacturer, but since then the price of alkali in all its forms having fallen, the quantity of salt decomposed without the utilisation of the acid, is decreasing rapidly.

sulphate of sodium by bicarbonate of ammonia, or substituting salt-cake for salt in the ammonia process, with the consequent utilisation of the chlorine, is still in the experimental stage, but since the Newcastle meeting a new process for uniting the Leblanc and ammonia-soda manufactures has been patented by Messrs. Parnell & Simpson, and is about to be worked on a large scale by the Lancashire Alkali and Sulphur Company, Limited.

This process is based on the decomposition of a mixture of solutions of common salt and ammonium sulphide by means of carbonic acid gas, the result of which is that sodium bicarbonate is precipitated as in the ordinary ammonia process, and sulphuretted hydrogen gas evolved, ammonium chloride being left in

TABLE G.

	SALT DECOMPOSED.				BLEACHING POWDER.	
	Total.	Metal Cos.	Brunner, Mond & Co.	Leblanc Alkali Manufacturers.	Made.	Proportion of Bleaching Powder to Salt.
						B. Pdr. Salt.
1852.....	137,547 Tons.	Estimate.	Mr. Allhusen.		13,160	1 : 10'6
1860.....	250,000	Estimate.	Allhusen and	Muspratt, for pur		pose of French Tre
1861.....	235,360				20,600	1 : 11'76
1862.....	251,600	Estimate	at time of cons	ideration of Alkali	Acts.	
1866.....	351,000	Report of	Hon. Secs. of	Alkali Association	47,006	1 : 7'46
1869.....	206,905	Estimate	handed to Com	missioners on Riv	ers Pollution, accord	ing to returns
		received	from 42 memb	ers of the Alkali A	ssociation.	
1871.....	352,350					
1873.....	Tyne, 187,850				Tyne 21 970	1 : 7'52
1874.....	439,756	Returns r	received from	50 Members of the	Alkali Association.	
1876.....	538,600	In 1877, Al	kali Manufact	urers' Association	commenced toissue	Annual Reports
1877.....	578,201	16,549	9,082	552,570	105,529	1 : 5'23
1878.....	568,542	17,158	16,230	535,154	105,044	1 : 5'09
1879.....	615,287	17,171	22,669	575,417	115,290	1 : 4'99
1880.....	700,016	24,013	27,416	648,587	131,606	1 : 4'99
1881.....	675,099	25,252	29,783	620,061	135,826	1 : 4'56
1882.....	679,935	24,188	56,914	598,833	135,170	1 : 4'42
1883.....	705,732	25,796	77,015	602,921	141,868	1 : 4'25
1884.....	690,502	21,869	89,759	578,874	128,651	1 : 4'49
1885.....	722,472	17,794	113,200	591,478	132,761	1 : 4'45

If the consumption of chlorine products bore the same proportion to the consumption of soda products as the chlorine does to the sodium in the salt, the future of the alkali trade would be less gloomy. The peculiar position of the soda industry since the development of the ammonia process is well known to the members of this Society, from the paper read by Mr. W. Weldon before the London Section in 1883, and the address he delivered as President at Newcastle. In the latter, he threatened both the Leblanc and the Solvay process with extinction by a third process, which was being worked out by Messrs. Pechiney et Cie., at Salindres. I have not been able to ascertain what progress has been made by Messrs. Pechiney since 1884, nor has any further information been given to the world as to the commercial success of Mr. Mond's and Mr. Solvay's various methods for utilising the chlorine in combination with the manufacture of alkali by the ammonia process.

The beautiful process of Messrs. Carey, Gaskell & Hurter for obtaining alkali by the decomposition of

solution. To recover the ammonium in the form of sulphide, the chloride solution is boiled with Leblanc alkali-waste, when a certain proportion of sulphuretted hydrogen gas is first evolved, and later ammonium sulphide and ammonia, which is condensed in brine for fresh treatment with carbonic acid gas. Since Leblanc alkali-waste is of no value, the advantages of this process over the ordinary ammonia process are—first, an entire saving of the lime used for the recovery of the ammonia in the latter process; and secondly, the recovery of the sulphur in the alkali waste in a form that at all events can be employed for the manufacture of sulphuric acid. It will at once be seen that there are drawbacks to the employment of the dilute carbonic acid obtained from the limekilns in this process, partly on account of the portion of oxygen that the limekiln gas nearly always contains, which would cause an oxidation of a portion of the ammonium sulphide, and partly from the difficulty of dealing with the dilute sulphuretted hydrogen that would be evolved after

the treatment of the brine and ammonium sulphide. The patentees have several alternative plans of meeting this difficulty, but the one which they have decided to work, and for which they are now erecting plant, is the employment of pure carbonic acid gas obtained by heating and decomposing ammonium bicarbonate. The latter is produced in an ordinary Solvay tower by treating a saturated solution of ammonium carbonate with limekiln gas; the crystals of ammonium bicarbonate are drawn off into a suitable vessel and heated to a temperature of about 160°F. , when nearly one equivalent of carbonic acid gas is driven off.

This gas after cooling contains only a fraction of a per cent. of ammonia, which is recovered in a wash tower in the usual way. The remaining solution of ammonium carbonate is then cooled, and returned to the towers for fresh treatment with lime-kiln gas, and thus the ammonia is kept constantly circulated. The carbonic acid thus produced is collected in a gas holder for use in the ammonium sulphide tower, while the sulphuretted hydrogen evolved from the latter is collected in another gas holder; this in both cases being necessary in order to have the process under proper control. It may at first appear that this preliminary preparation of pure carbonic acid gas will involve twice as much work in the towers as is the case in the ordinary ammonia process, and that consequently a greater loss of ammonia may be anticipated. The total amount of gas escaping, however, is only increased by the amount of sulphuretted hydrogen produced, or say about 25 per cent. of the total volume passed into the towers, so there is no serious ground for apprehension on this score. The ash produced by this process seems to be in no way inferior to that obtained by the ordinary ammonia process.

The process is very interesting both from a scientific and practical point of view, as it combines the Leblanc and ammonia processes, and proposes to recover the sulphur in the alkali waste in a mercantile form, and so extinguish the nuisance from the waste heaps to which I have already alluded. But it has one defect, and that is it will produce a larger quantity of alkali, and this is serious, as there is apparently more produced at present than the market will bear. It is true the alkali made by the Leblanc method will take the form of caustic soda, and that by the decomposition of bicarbonate of ammonia the form of soda ash, but for every 70 tons of caustic soda we shall have an additional 100 tons of alkali.

It is clear therefore that if the process is successful, both the present ammonia soda works and the Leblanc alkali works must still further reduce their output.

I have in the foregoing given a short account of the alkali industry in this neighbourhood, with its allied industries of copper and chlorine products. It has of course attracted round it other industries such as the manufacture of glass and soap, but these are now principally in St. Helens, Warrington, and Widnes, whereas in Liverpool, where there were seven or eight soap works in 1827, there are now only two small ones.

At St. Helens, in 1829, the first alkali works was erected, and there were then only five small glass works; now there are eight alkali works, nine large glass works, four of them manufacturing plate glass. Of copper-smelting works there was only one in 1829; to-day there are five, and two copper-extracting works, and the population has increased from 14,251 to 61,472 at the last census.

In Widnes the progress has been still greater, as its rise as a manufacturing town dates from about 1848, and it now contains 15 alkali works, most of them of large size, four copper works, and the large soap works of Messrs. W. Gossage & Sons.

All this is now placed in jeopardy by the advance of chemical industry. Professor Dumas, in addressing the Société d'Encouragement pour l'Industrie, in 1860, at a time when by the Treaty of Commerce with England the French manufacturers were about to be brought into competition with their English rivals, made use of these remarkable words, which contain a great truth:—

“Europe has always accepted our supremacy in the chemical arts. Let us preserve it with care. It is by means of it, and of its unforeseen conquests, that the balance of trade is often overthrown.”

France since then has seen her supremacy in this particular direction rudely shaken by Germany, which has made enormous strides in all chemical manufactures.

We in England at that time thought ourselves quite safe from all foreign competition, but we are now also beginning to recognise that by the conquests of science the balance of trade may be altered. The Leblanc may have to succumb to the ammonia soda, and under these new conditions foreign countries are becoming less dependent upon us for alkali. If chloride of magnesium is used to replace salt as the raw material for chlorine, this great chemical industry will, of necessity, have its seat in Stassfurt, and not in Lancashire. In a paper read before the Manchester Section, Mr. Levinstein quotes from a speech by Professor Bayer (the discoverer of artificial indigo), in which the learned professor showed how Germany had succeeded by means of her intellectual achievements in wresting from France and England, countries superior in natural resources, a source of national wealth in the colour industry. Mr. Levinstein seems to be of opinion that at the present time English colour manufacturers are placed in a worse position than their German rivals, owing to the higher price obtained by English alkali makers for their products, and that the latter are unable to compete with the Germans because for special reasons sulphuric acid and soda ash are at present dearer in England than in Germany. Although I have no reason to doubt his statements so far as the price of alkali in Germany is concerned, the fact that the German manufacturers sent a parcel of caustic soda to England, and that ammonia soda of German make is offered at £5 10s. per ton in London, proves nothing as to the normal price of alkali in the two countries. I have no doubt the Leblanc makers themselves would sell 58 per cent. soda ash in London at £5 10s. per ton, if they could not dispose of their alkali to better advantage in the shape of caustic soda, and it is well known that Messrs. Brunner, Mond & Co. are prepared to meet any competition of the German alkali manufacturers either in this country or abroad.

But Mr. Levinstein's second and more serious complaint refers to sulphuric acid. I think he rather exaggerates the advantages we possess in the price of the raw materials, pyrites and nitrate of soda, since freights to Antwerp are as low as to our own ports, and the internal carriage throughout Germany, whether by canal or railway, is very reasonable. Although German labour in this department is lower than in England, I think any of our large alkali manufacturers are able to make sulphuric acid as cheaply as his German rival, and if it pays the German manufacturer to deliver acid of 66 Beaumé at £3 per ton, it can only be because the cost of delivering from the Griesheim works to Frankfort is less than from the English alkali works to the place where the acid is consumed. The question of transportation is a very serious one, and English manufacturers are undoubtedly heavily handicapped by the difficulties put in their way by the railway companies.

If the quantities of sulphuric and hydrochloric acids consumed in one German colour works are generally so large as the figures given by Mr. Levinstein indicate, the English alkali manufacturer will pray that several of these works may be erected in England and so relieve the Leblanc makers of their acids.

As to the remedy, I quite agree with Mr. Levinstein, that it is not the theoretical chemist, but the chemical engineer that fails us.

The records of the progress of the alkali manufacture show that most of the processes now used are old, and that it is in the apparatus employed that the greatest improvements have been made; but while a few of our manufacturers have shown that they fully recognise this, it is very difficult to find a manager who has a knowledge of engineering combined with a knowledge of chemistry. Such men must be educated, and it is only now, after the Germans and French have shown the way for forty years, that we are beginning to follow in the path.

This laboratory, in which we are met, is but a sign of the movement that is in progress, and our Chair of Engineering in Liverpool has only been founded one year, but I look forward to the not distant day when by means of improved secondary education, and the work of institutions like Owens College, and University College, Liverpool, our manufacturers will be able to find men ready to carry on, with even greater success than in the past, a large portion of the great chemical industry of the world.

Sir HENRY ROSCOE, M.P., moved that the hearty thanks of the Society be accorded to the President, Mr. E. K. Muspratt, for his valuable address. He said it was a matter for congratulation that one who bore the name of Muspratt should have presided on that occasion, for that name was connected intimately with the birth, rise, and progress of one of the greatest of English chemical industries. He took, moreover, that opportunity of expressing the sincere sympathy of the Society with the family regarding the death of Mr. James Muspratt, the originator of that great industry.

Mr. DAVID HOWARD (the President-elect) seconded the motion, and it was carried with acclamation.

THE NEXT ANNUAL MEETING.

Mr. E. C. C. STANFORD then moved that the Society should meet next year in Glasgow, the seat of the Glasgow and Scottish Section, and he assured the members that they would there receive a hearty reception and a warm welcome.

Mr. TYRER seconded the motion, and it was unanimously adopted.

VOTES OF THANKS.

On the motion of Mr. TYRER, seconded by Mr. LUDWIG MOND, a hearty vote of thanks was then passed to Mr. E. K. Muspratt for his valuable services to the Society as President during the past year. Votes of thanks were also given to Mr. R. Weldon for the presentation, in accordance with the known wish of his father, of the valuable collection of the scientific books of the latter to the Society, and to the Council and Senate of the University College for the use of the lecture theatre.

ALTERATIONS IN BYE-LAWS, AND THE RAISING OF THE ANNUAL SUBSCRIPTION OF MEMBERSHIP.

Upon the motion of Mr. JOHN SPILLER, seconded by Mr. C. C. HUTCHINSON, it was resolved, "That the following alterations be made in the Bye-laws"—

Bye-law 1. —That the words "and is established in accordance with the provisions of the Literary and

Scientific Institutions Act, 1854," be added after the word "Industry."

Bye-law 5. —That the word "or" be inserted in the third line thereof between the words "Council" and "a professional."

Bye-law 27. —That the words "One Guinea" in the first line thereof be replaced by the words "Twenty-five Shillings."

Bye-law 29. —That the words "is more than four months in arrear," in the second line thereof, be replaced by the words "has not been paid."

Bye-law 37. —That the word "President" in the second line thereof be replaced by the word "Chairman."

Bye-law 42. —That the words "is in arrear with" be replaced by the words "has not paid."

Bye-law 49. —That the date "31st of December" be replaced by the date "15th of June."

Bye-law 54. —That the word "given," in the last line but one thereof, be replaced by the word "posted."

Mr. DAVID HOWARD proposed the reappointment of Messrs. Theobald Brothers & Miall as auditors, a proposal which was seconded and carried.

The result of the scrutiny of the balloting papers was now reported by the scrutineers, and showed that the following had been elected ordinary members of Council:—

Dr. John Evans, F.R.S.	S. A. Sadler.
Henry Doulton.	John Calderwood.
Ivan Levinstein.	John Pattinson.
Sir Bernhard Samuelson, Bart., M.P.	Eustace Carey.
Sir Chas. Tennant, Bart.	Lewis T. Wright.
R. Forbes Carpenter.	S. H. Johnson.

The nominations of Council for President, Treasurer, Foreign Secretary, and Vice Presidents are confirmed.

(Signed) ALFRED E. FLETCHER.
A. NORMAN TATE.
AD. LIEBMANN.

The following is therefore the composition of the Council for 1886—1887:—

President: David Howard.

Vice-Presidents:

Sir I. Lowthian Bell, Bart., F.R.S.	Sir H. E. Roscoe, M.P., F.R.S.
Prof. James Dewar, F.R.S.	John Spiller.
Dr. Peter Griess, F.R.S.	E. C. C. Stanford.
Dr. Ferdinand Hurter.	J. C. Stevenson, M.P.
E. K. Muspratt.	John Williams.
Dr. W. H. Perkin, F.R.S.	Philip J. Worsley.

Members of Council:

John Calderwood, F.R.S.E.	John Pattinson.
Eustace Carey.	S. A. Sadler.
R. Forbes Carpenter.	Sir B. Samuelson, Bart., M.P.
Henry Doulton.	Sir Chas. Tennant, Bart.
Dr. John Evans, F.R.S.	Lewis T. Wright.
S. H. Johnson.	
Ivan Levinstein.	

Treasurer: E. Rider Cook.

Foreign Secretary: Ludwig Mond.

THE ANNUAL DINNER.

The Annual Dinner of the members of the Society of Chemical Industry was held in the Adelphi Hotel, Liverpool, on Wednesday evening. There was a fair attendance, but it was scarcely so large as on some previous occasions of a similar character. The chair was occupied by the President (Mr. E. K. Muspratt), who was supported by Sir H. E. Roscoe, M.P., F.R.S., Sir James Picton, Mr. David Howard (the President-elect), Mr. Ludwig Mond, Prof. J. Campbell Brown, Mr. Ivan Levinstein, and Dr. Hill (Mayor of Bootle), and others. The usual loyal toast having been proposed and duly honoured.

Sir HENRY ROSCOE, M.P., F.R.S., proposed "The City and Trade of Liverpool," coupling with it the name of Sir James Picton. He referred to the fact that it was intended to hold a Jubilee Exhibition next year in Manchester, in which the illustration of

the chemical industries and their advance during the Victorian era will be a principal feature.

Sir JAMES PICTON, in response, referred to the connection of the Roscoes with Liverpool, and said that the family showed no signs of falling off in the third generation. He defined the science of chemistry, or perhaps applied chemistry, as the bringing to bear of certain of the forces of nature upon natural substances, so modifying them as to render them serviceable for mankind. As an outsider, he thought that, much as chemists had done, they were still open to reproach in regard to the state of affairs in the neighbourhood of some of their works: for, although he had been informed that in some cases Widnes and St. Helens were regarded as sanatoria, and patients were occasionally taken there to inhale the atmosphere, people did not take their families there as they took them to Buxton. Cologne, too, with its three hundred stinks, was the home of the manufacture of the queen of perfumes. The story of chemical discovery was far from being yet told, and the man who could reduce the metal aluminium from the abundant clay at a low cost would deserve a good reward.

In proposing the toast of "The Guests," which was responded to by Dr. HILL, Mayor of Bootle, Dr. CAMPBELL BROWN said that on one occasion he had actually been asked to prepare some Widnes gas for administration to a person who was ill.

The PRESIDENT next gave the toast of the evening—"The Society of Chemical Industry." He said the fact that it now numbered over two thousand members showed that it filled a void in the world of societies which had sprung up during the present century. As Sir Lyon Playfair said in his address to the British Association, the competition of nations now was a competition of knowledge and of science, and it was only by the possession of these, in an equal if not superior degree, that we could expect to hold our own with the other industrial nations of the world. By the application of science, and particularly of the science of chemistry, we had seen in those parts of Russia only lately conquered from the Turks a wonderful extension of trade and commerce. The port of Batoum, where there was an enormous trade in petroleum, was an instance of how the application of science was gradually altering the balance of trade; and there were many other instances of it. The application of petroleum instead of coals as a motive power in vessels would certainly effect a remarkable change in the commerce of the world. In coupling with the toast the name of Mr. David Howard, the President-elect, he alluded to the fact that Mr. Howard was a member of a firm established so far back as the year 1789, or about thirty years after the birth of modern chemistry in the discovery of oxygen.

Mr. HOWARD, in responding to the toast, said he thought the Germans were our most dangerous rivals in chemical science, but he did not think we need fear them if we devoted patient, unceasing work and indomitable courage to the development of chemical science and chemical industry combined. The rivalry must, however, be a friendly one, for how could they be at enmity with a people from whom they had learned so much. He himself had received his chemical training from Professor Hofmann, in the glorious old cockpit of the College of Chemistry. Undoubtedly, the study of pure science was much more attractive than the development of applied science. Pure science was the Pegasus that soared aloft, but we were bound to put him to the plough; and though he might not like it, we should find that he would be an invaluable animal for the most homely and useful work. Pure science could tell us what was

the composition of the stars, but it could also tell us what to do with our sewage. So, if only we were content to take the teachings of pure science, and put to them all that hard work which used to characterise Englishmen—and he did not think it would be found that the race had degenerated—he thought we should find that there was a future of great prosperity for our commercial industry, even greater than it had enjoyed in the past.

The toasts finally proposed and responded to were, "The Health of the President," and "The Officers of the Society."

THE EXCURSIONS, ETC.

The International Exhibition in Liverpool was visited by a number of the members on *Wednesday afternoon*, whilst others visited and inspected the Sugar Works of Messrs. Crofield, Barrow & Co.

On *Thursday morning* a considerable number of members embarked at the Prince's Landing Stage, on a special saloon steamer, for a trip on the River Mersey. The North Docks were entered, and the New Floating Docks, Graving Docks, with the Hydraulic Machinery, were visited and inspected. The New Grain Warehouses and Elevator were then visited, and a large Transatlantic Steamer, on which lunch was provided. Another portion of the visitors called at Seacombe,* and lunched there. The party then proceeded to the Ship-building Yard of Messrs. Laird Bros.

On *Friday* two parties were organised, one for visiting Widnes, the other St. Helens. The former visited the Soap Works of Messrs. Gossage & Sons, the Alkali Works of Messrs. Gaskell, Deacon & Co., and Messrs. The Tharsis Sulphur and Copper Co., Limited; the latter, the Collieries at Sherdley, of Messrs. Bourne & Robinson, and the Glass Works of Messrs. Bishop & Co. In the afternoon the London and North-Western Steel and Railway Works at Crewe were visited, and on the return to Liverpool an informal Wind-up Dinner was partaken of at the Adelphi Hotel.

THE CONVERSAZIONE AND RECEPTION.

On *Thursday evening*, at eight o'clock, the President held a Reception at the Walker Art Gallery. Some excellent instrumental music and singing were provided, and the Conversazione was attended by about four hundred ladies and gentlemen.

London Section.

CHEMICAL SOCIETY'S ROOMS, BURLINGTON HOUSE.

Chairman: David Howard.

Committee:

Sir F. A. Abel.	R. Messel.
H. E. Armstrong.	B. E. R. Newlands.
W. Lant Carpenter.	B. Hedwood.
W. Crowder.	T. Royle.
C. Graham.	John Spiller.
S. Hall.	G. C. Trewby.
A. K. Huntington.	J. Williams.

Local Sec. and Treasurer: Thos. Tyrer,
Garden Wharf, Church Road, Battersea, S.W.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

* At Seacombe a group of the members was formed, and very successfully photographed by Messrs. Robinson & Thompson, 57, Bold Street, Liverpool, from whom unmounted or mounted reprints may now be had on application at a reasonable cost.

Liverpool Section.

Chairman : Prof. J. Campbell Brown.

Vice-Chairman : Dr. F. Hurter.

Committee :

J. Atleek.	F. Hurter.
E. G. Ballard.	J. W. Kynaston.
Ernest Bibby.	E. K. Muspratt.
H. Brunner.	Jas. Simpson.
J. C. Gamble.	A. Norman Tate.
D. Herman.	Alexander Watt.

Local Sec. : W. P. Thompson, 6, Lord Street, Liverpool.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Manchester Section.

Chairman : Sir H. E. Roscoe, M.P.

Vice-Chairman : L. Levinstein.

Committee :

Dr. Bowman.	C. Schorlemmer.
R. F. Carpenter.	Dr. Schunck.
C. Estcourt.	Dr. Watson.
H. Grimshaw.	Wm. Thomson.
Peter Hart.	L. Siebold.
Dr. Gerland.	Dr. Hewitt.

Local Secretary :

J. Carter-Bell, Bankfield, The Cliff, Higher Broughton, Manchester.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

A NEW SYSTEM OF FILTRATION FOR LARGE QUANTITIES OF WATER.

BY ALPH. STEIGER,

Consulting Engineer.

FROM the earliest up to the present times the supply of pure water for the population of towns has always been considered a question of the utmost importance; it is a question which even now-a-days occupies the minds of engineers, chemists, sanitary officers and magistrates.

When our ancestors of many centuries ago began to settle down in enclosed colonies called towns, the latter could not be more favourably situated than on rivers, and all over Europe we find traces of such towns, while away from rivers there was hardly anything found to prove the former existence of colonies. In these times the rivers were almost the only way of transit of commerce, and may at the same time have been sufficient for the supply of water for domestic purposes. In any case there were not the same difficulties and circumstances which in the present time accompany the question before us. In consequence of civilisation and the development of industries the density of the population of towns is continually increasing, and while the want of water necessarily increases in the same proportion, the water of the rivers, ponds, etc., becomes polluted by the waste of all kinds of manufactories and even animal excrements. Water from wells is very seldom abundant near towns, and therefore, acknowledging the necessity of clear water, without odour or taste, for drinking and other purposes, the question of a large supply of such water is rendered very difficult.

Two ways have hitherto been followed to provide towns with a sufficient quantity of water: *firstly*, by conducting the water from distant places, lakes, or rivers to the towns, as has, for instance, been done for the water supply of Vienna, Paris, Liverpool, etc.; and *secondly*, by the erection of large sand-filters as have first been erected in Chelsea for the water

supply of the metropolis, now over fifty years ago. Enormous sums have been expended by large and even small communities for carrying out both projects, and give ample evidence of the importance of the object in question. However, the result in many cases was not in proportion to the cost, and the excellent report of the River Pollution Committee in 1874 has clearly shown that the sand-filters do not remove the soluble organic matter from the water. But it has been reserved to the last few years to discover something much worse than even this. It is the undeniable fact that the water contains a large amount of micro-organisms, the originators of epidemic diseases.

In many places and on different occasions it has been observed that people using a certain kind of water were infected by these diseases, whilst others using water from another source were not infected; it has even been possible to trace the water supply from the way the disease followed. It is unnecessary to prove these facts here; but we may be allowed to mention that in the town of Zurich, a few years ago, when the typhoid fever raised the percentage of mortality considerably—which was attributed to the quality of the water drawn from the lake of Zurich and filtered through sand-filters, used in some parts of the town—it was taken into consideration whether better water could not be obtained from the wells in Waeggithal, Ct. Schwyz, which project would have cost tremendous sums of money, and besides, it was stated, that during some parts of the year even this water was not free from bacilli, and might convey the origin of epidemic diseases.

In most places where sand-filters are used, the water from the supply is found to have a distinct taste and odour of organic matter in a state of putrefaction during warm weather, as, for instance, in Manchester, rendering the water almost unfit as a beverage. In consequence of this we find in all the houses of the better class special carbon filters, through which the water is again filtered, but these small filters are only for the privileged classes which can afford to pay for them, while the poorer people have to be satisfied with the water as it issues from the sand-filters, containing certain quantities of suspended organic matter.

As regards the small house-filters, of which the filtering substance consists mainly of animal charcoal or spongy iron, it must be said that they are so far excellent filters during a certain time, retaining even micro-organisms, but they do not prevent the development of the latter, and become occasionally a real eldorado for the growth of micro-organisms. The same occurs in sand-filters. The best and purest water from them is obtained a short time after they have been in action, when the pores have been rendered finer by the deposits of suspended matter. But the organic matters begin to grow, prevent the whole amount of water from passing through the filtering substances, or it forces its way through, carrying with it organic matters which are deposited in the main-pipes conducting the water to the place of consumption. It is then found necessary to clean the filters, for which purpose the whole filtering mass, sand and stones, must be taken out, carefully washed, and afterwards put into the place again, a work which requires a considerable length of time, during which the filtration is interrupted and which also causes great and continued expense. When the filters are at work again, the source of growth of micro-organisms is not only in the water before and in the filter, but also afterwards, and the filtered and pure water will become infected by organic matter; this may have been the case in Zurich, in Manchester, and many other places. But even if not, micro-

organisms appear again in filtered water, as we learn from Dr. P. Frankland's interesting paper on "New aspects of filtration and other methods of water treatment," even if immediately after filtration no such organisms could be found. This must necessarily raise the question whether the presence of these organisms in the water could not be prevented, or whether they could be destroyed in such a way that they offer no more danger of epidemic disease.

We have taken into consideration above the high value of pure water for the supply of the population in general, and I must now turn to the different industries requiring also a pure water, at least to a certain degree. I mention, in the first instance, the breweries, for which a pure water is of vital importance.

The process of fermentation in brewing still remains in mystic darkness, and it has as yet not been scientifically established why in one case the yeast thrives well and produces an excellent fermentation, while in another case the development of the yeast is most incomplete and insufficient. It has only been confirmed that foreign substances, and chiefly low organisms suspended in the water, are the principal cause of preventing the growth of the yeast. The principal breweries of Frankfort-on-the-Maine, which are using the very pure water of the abundant wells which supply that town, obtain an excellent and quick fermentation, while other breweries, less fortunate in the resources of their water, cannot obtain such satisfactory results without erecting perfect sand-filters, taking up an area, which can only be done at great expense, and further, causing continued and considerable working expense.

Paper mills also require a very pure water, and in such large quantities as would be sufficient for a small or middle-sized town. 80 to 120 gallons of water are required for the manufacture of one pound of paper, and it is evident that such large quantities can hardly be obtained without a perfect system of filtration. The value of pure water for the manufacture of certain of the better qualities of paper is best illustrated by stating that 1 *per mille* of certain impurity in the water may render the paper unsaleable; in other words, a perfect filtration is capable of raising the value of the manufactured goods.

Chemical works, bleaching, dyeing and finishing works also require pure water, and in many cases, not having their own filters, draw their water from the supply of the town, paying heavy rates for it.

From the foregoing the following facts are derived: (1) pure water is of an absolute necessity for almost any purpose; (2) the ordinary sand-filters do not answer in most cases, because they are not able to remove the organic matter; (3) they take too much space and cause too much expense for the erection and the working; (4) filters using spongy iron, charcoal and other material are too expensive if used for large quantities of water, and the small house-filters are a privilege of those who can afford to pay for it.

This at once tells us what we must expect from a really good system of filtration, and what the conditions of a perfect filter are; we may number them as follows:—

1. The filters must purify the water chemically and mechanically.
2. They must destroy the life of germs and micro-organisms.
3. Their cleansing must be made easy and without causing great expense.
4. They must be more economical with regard to space and cost.

Since the introduction of sand-filters scarcely any improvement in their construction has been made,

and the sand-filters of the present time are of the same style as fifty years ago. The system of filtration which I am going to describe may be mentioned as the first and most important progress in the filtering of large quantities of water. It fulfils all the above-mentioned conditions in a most efficient and satisfactory manner, and its use in several places on the continent for many years proves it to be a great success. It is the filtering system of Dr. Gerson in Hamburg.

According to the above conditions of a good filtration, the characteristics of this system are as follows:—

1. The filtration is divided into a preliminary and a secondary filtration.
2. In both the preliminary as well as the secondary filters, the water passes through the filtering substances from bottom to top.
3. The filters are cleansed by reverse currents of filtered water, the changing of the filtering substances consequently avoided or only exceptional.
4. It removes and destroys most of the micro-organisms suspended in the water by the peculiarity of the filtering substances.

The impurities in the water being of different size and character, the preliminary filters are intended to remove the coarser matter, while the very fine low organisms are retained by the secondary filters. The filtering substances can thus be selected accordingly, and are of different kinds and fineness in both filters. It is evident that thus a greater filtering capacity is obtained, and that the preliminary filters for the mechanical action can be working under high pressure. Their capacity is 200 times larger than the capacity of the ordinary sand-filters, which means that for the same quantity of water they take only $\frac{1}{200}$ of the space of the latter. They always work under high pressure, which, however, does not exceed 13 feet, and consist of two tanks, of either masonry or iron, which are connected to each other, and form one set; they can alternately be cleansed by reverse currents of filtered water while the other tank is working.

The secondary filters, which remove the fine organic matter suspended in the water, can, according to local circumstances, be worked either under high pressure or low pressure; in the first case, their capacity is about half the capacity of the preliminary filters, and the total pressure for both filters 25 to 29 feet, while, in the second case, under low pressure—namely, about 32 inches—they require 10 times the surface of the preliminary filters, but still exceed the capacity of sand-filters 25 times.

In some cases, where it is sufficient to remove only the coarse matter, or where the water does not contain much impurity, a preliminary filter alone will suit the purpose, as, for instance, in breweries, for the soaking of malt and washing purposes, whilst the water for the brewing process proper can pass through a secondary filter specially put in for this purpose.

It is evident that by the arrangement of this double filter the water is thoroughly freed from all the suspended matter, and the water has to pass a longer way through the filtering mass than in ordinary sand-filters. This process is similar to the process which takes place in nature in the filtration of rain-water. We shall soon see that, while the mechanical filtration takes place principally in the preliminary filters, the chemical action upon organic matters is accomplished in the preliminary as well as in the secondary filters.

The chemical action must obviously not be caused by soluble substances, as their presence in the filtered water would render it unfit for almost any use, because of the odour or taste or chemical action of the antiseptic. The filtering substances in Dr. Gerson's

filters are impregnated with the almost insoluble tannate of iron, and thus the sponges used in the preliminary filters, and which otherwise are liable to decomposition and putrefaction, become impregnable. Microscopical examination of such sponges shows all the fibres filled with amorphous tannate of iron. They are used in the preliminary filters in a compressed state, and can easily be washed without losing their quality. Also, the sand and pumice-stone used in the secondary filters are impregnated in the same way, and the water is exposed to the action of the tannate of iron all through both filters.

The antiseptic qualities of the tannate of iron were known for a long time, but could not possibly be better demonstrated than by the following striking fact:—The population of a small village in France, called Bessé-sur-Braye, was often afflicted by typhoid and mucons fever about fifty years ago, and the mortality was very considerable. Since the erection of dyeworks on the river above the village, in which tannate of iron is continually used, cases of the above-named diseases are very scarce, and seldom prove fatal. The waste water from the dyeworks goes into the river which supplies the village with water filtered through the soil, which becomes impregnated with the tannate of iron. The manager of these works, Mr. Rolland, wrote at once to Dr. Gerson, when he heard of his filtration system, stating that he could only attribute this fact to the action of tannate of iron.

We have already pointed out the necessity of keeping the filters clean, and the difficulties and expense incurred in this respect by the sand-filters. Dr. Gerson provides different means for cleansing his filters, which are most efficient, and secure a better result at less expense in money and time. As the water enters the filters at the bottom, where consequently the suspended matter is caught and retained, a reverse current of water is quite sufficient for removing the suspended matter. The pipes supplying the filter with water, as well as the bottom of the filter, are provided with valves specially for this purpose, and while the admission of water to the filter is stopped, the filtered water passes through the filtering substances in the opposite direction, and is emptied with the suspended matter through the valve at the bottom of the filter. In six to ten minutes the operation is finished, and the filter again ready for use. During the cleaning, the filtering substances, which are placed in layers between sieves, may be compressed, and thus more thoroughly cleaned. Should it be found necessary to change the filtering substances, or to inspect them, this can be done in the short time of two or three hours, after which the filter will be ready again for use. This, however, occurs only exceptionally, and in one case the filtering substances had to be taken out for a thorough washing only after two years' use.

I have already stated that the capacity of Dr. Gerson's filters is much higher than that of the ordinary sand-filters. The illustrations Figs. 1A and 1B, in the scale of 1 : 200, shows the space required for the same capacity by the sand-filters, and, with Dr. Gerson's system, the preliminary filters in the latter working under high pressure and the secondary filters under low pressure. For the preliminary filters, basins of concrete may also be used, allowing existing filtration plants to be converted to Dr. Gerson's system.

Fig. 2 illustrates a filtration plant for breweries, in the scale of 1 : 50, for a capacity of 400 hectolitres (90,000 gallons) per twenty-four hours—*a* being the receiving tank, about 16 to 20 feet above the top of the preliminary filters, *b* the feeding pipes, *c* the preliminary filters, *d* pipe conducting the water from the preliminary filters to a small tank, *e*, above the

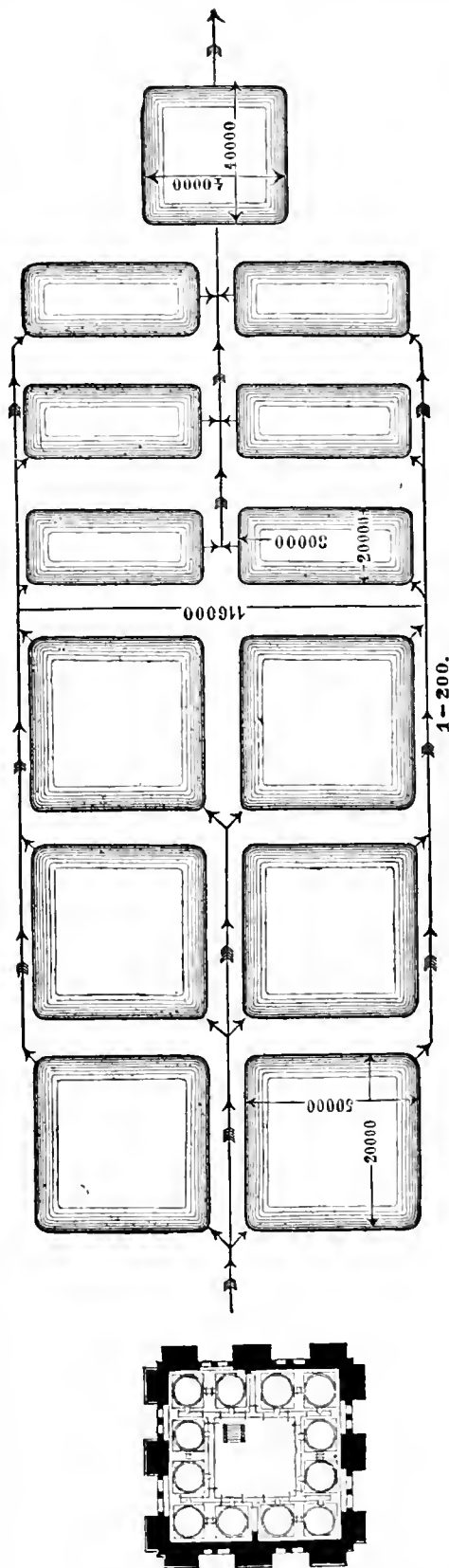


FIG. 1A.—ORDINARY SAND FILTRATION.

FIG. 1B.—DR. GERSON'S FILTER

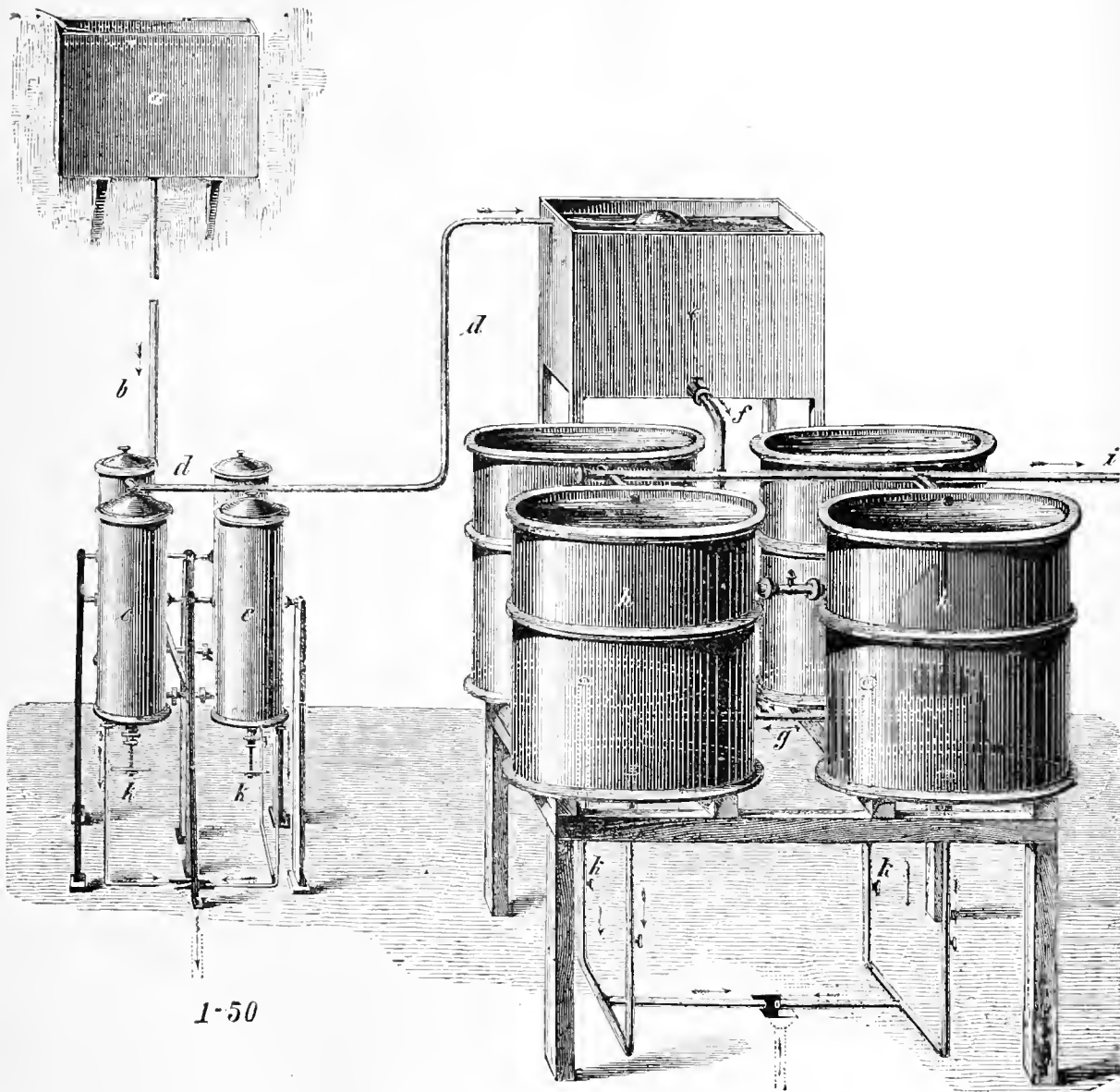


FIG. 2.

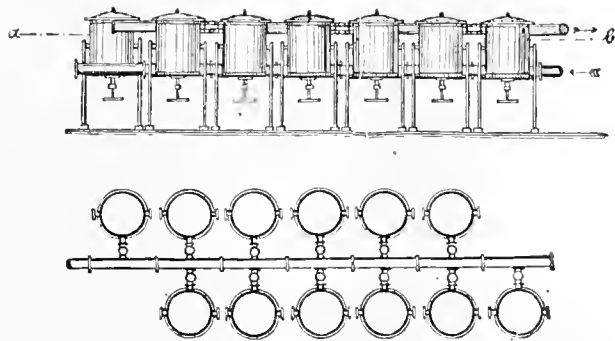


FIG. 4.—BATTERY OF SIX PAIRS OF FILTERS.

secondary filters, *f* and *g* pipes feeding the secondary filters, *h*, *i* discharging pipe for the filtered water, and *k* pipes discharging the cleaning water from the reverse currents.

Fig. 4 represents a battery of preliminary filters, with six pairs of cylinders, which take up a space of only 1050 square feet, while the secondary filtration is performed in a tank of 1016 square feet of surface.

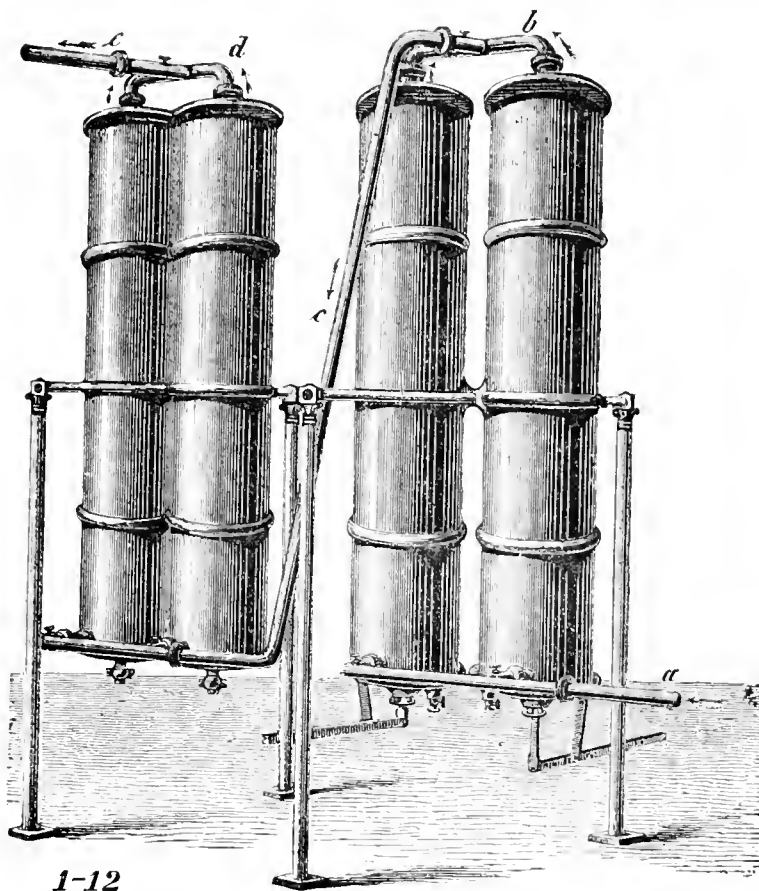


FIG. 3.

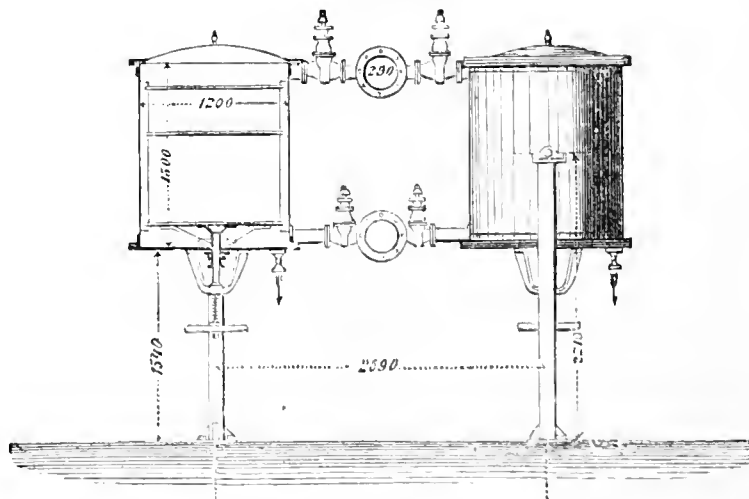


FIG. 4A.—ONE SINGLE PRELIMINARY FILTER FOR ASTRACHAN.

Fig. 3 (scale 1:12) shows a set of preliminary filters and a set of secondary filters, both working under high pressure, for a capacity of 150 hectolitres (33,600 gallons) per twenty-four hours.

This plant was erected for the city of Astrachan, in Russia, several years ago, and corresponds to a capacity of 5000 hectolitres (1,120,000 gallons) per twenty-four hours.

Fig. 5 gives another instance for the use of this filtration system—namely, for the supply of troops with drinking water on the march or in camp. It is a pump connected with the filters fixed on a vehicle. With such an apparatus, a battalion can, in the shortest time, be supplied with clear and pure water, taken from whatever it may be, river or pond. Official trials with this portable filter have already been made by the German and Italian armies, and proved most satisfactory. Their introduction depends, of course, upon the possibility to augment the number of vehicles for the army; but the great service which these filters

	Un- filtered.	Filtered through Dr. Gerson's system.
Residue after evaporation (130° C.) ...	4·800	3·540
Ammonia	—	—
Nitric Acid	traces	traces
Hydrochloric Acid (HCl)	0·592	0·374
Sulphuric Acid (H ₂ SO ₄)	1·144	0·563
Lime (CaO)	1·100	1·100
Magnesia (MgO)	0·382	0·216
Oxygen required for the oxidation of organic matter	0·097	0·076

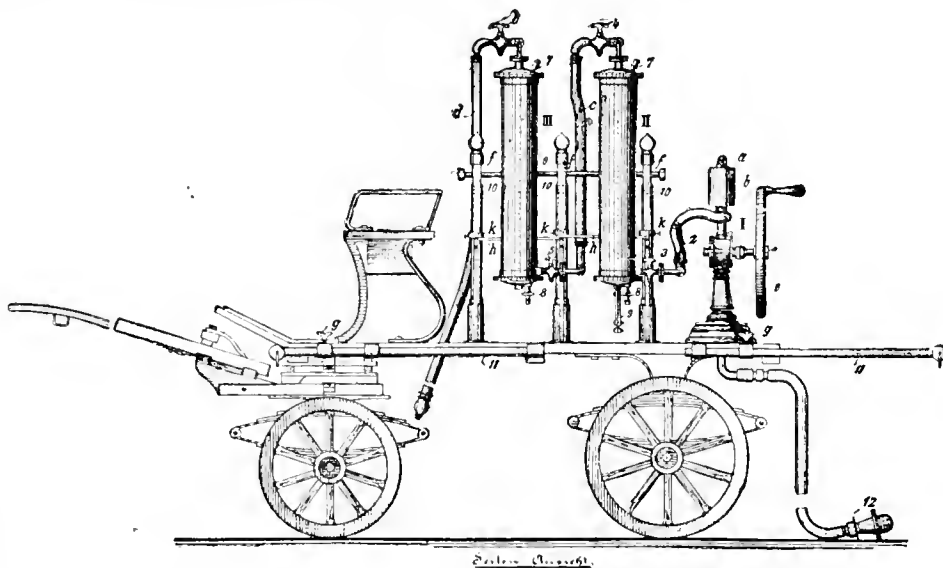


FIG. 5.—PORTABLE FILTERING PUMP FOR QUARRY PURPOSES.

would render, in hot climates principally, preventing diseases spreading amongst the troops, is of greater importance than the economy, often going too far, in such useful implements.

Before concluding my description of these filters, I will give a few analyses of water, giving the results obtained from sand-filters in comparison with Dr. Gerson's filters. The quantity of organic matter has been determined by the consumption of oxygen for their oxidation:—

	Oxygen.
Analysis by the German Imperial Sanitary Board—	
Water from the Elbe, unfiltered	0·365
Filtered through sand	0·316
Analysis by the German Hygienic Institute—	
Water from the Elbe, unfiltered	0·420
Filtered through sand	0·400
Analysis by Dr. Niederstedt, in Hamburg—	
Water from the Elbe, unfiltered	0·373
Filtered through Dr. Gerson's filter	0·11
Analyses by Messrs. Senurier & Lubeen, in Amsterdam—	
Water from the downs, at Amsterdam, unfiltered	0·23
Filtered through sand	0·22
Water of the Schie, near Rotterdam, unfiltered	0·29
Filtered through Dr. Gerson's filter	0·17

Analysis by Mr. Stein, Town Chemist at Copenhagen—

Water from the canal of the water supply, cleared through standing:

Microscopical Examination.

Unfiltered water.

Tails of algæ, vortochææ, infusoria, wire bacteria, dust bacteria, oscillariseæ, palmellaceæ, pedicostæ, desmidiæ, diatomeæ, green wire algæ, living crabs, and some urchins.

Water from Dr. Gerson's filters.

No organisms found.

NOTE ON SACCHARINE.

BY IVAN LEVINSTEIN.

At the meeting of the Liverpool Section held on May 5, 1886, the question was raised by Mr. Brunner as to the therapeutic action of saccharine, and Mr. Tate promised to make experiments on this substance, and to communicate the results to the Society. Now, without in the least intending to forestall any of Mr. Tate's results, I thought that it would be of interest to many, and also possibly of assistance to Mr. Tate, to briefly refer to the hitherto published evidence of the innocuous character of saccharine. Two Italian physiologists, Arduceo and Mosso, have studied the physiological action of this body some time ago. An abstract of their investigation is published in that excellent Journal, *The Medical Chronicle* (the April number, 1886). They found that frogs could be kept for days, and without the least injury, in a neutralised aqueous solution of saccharine. Dogs showed no ill effects when saccharine was administered in increasingly large doses, up to 5grms. per diem for several

days together. The body weight remained unaltered. The saccharine was discovered unchanged in the urine, apparently undergoing no change in its passage through the body. It does not influence the quantity or specific gravity of the urine, nor does it cause any change in the urea and sulphuric acid excreted. The chlorides are slightly increased. The presence of saccharine in the urine delays decomposition. Dr. Stutzer of Bonn, as well as Arducco and Mosso, obtained similar results with the human subject, 5grms. daily being found to have no ill effect, passing away by the kidneys, and appearing neither in the saliva, in the milk, nor in the feces; the appetite remained unaffected. Now, 5grms. of saccharine, as already stated in my former paper (this Journal, 1886, 76), are equal in sweetening power to more than two and a quarter pounds of sugar. Stutzer's investigations have been quite recently confirmed by Professor E. Salkowski (*Firchow's Archiv*, vol. 105, p. 46). In diabetes, Professor Dreschfeld, of the Victoria University, the Owens College, Manchester, has determined that no alteration takes place either in the quantity of urine or the quantity of sugar passed. Saccharine has scarcely any retarding effect on the digestion of either proteids or carbohydrates, and in two cases of acid dyspepsia Dr. Dreschfeld found that it relieved some of the troublesome symptoms. Stutzer has noticed that, added in small quantities, it increases the diastatic action of malt in presence of sugar.

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Communication.

THE VOLUMETRIC TEST FOR MANGANESE.

BY JOHN PATTINSON, F.L.C., F.C.S.

IN a paper on the Estimation of Manganese, read by Mr. R. W. Atkinson at the April meeting of the Bristol and South Wales Section, and published in the June number of the *Journal of the Society of Chemical Industry*, the author calls in question the accuracy of the volumetric test for manganese published by me in a paper read before the Chemical Society, and printed in the *Journal of the Chemical Society* for June, 1879. The test experiments made by me at that time to establish the accuracy of my volumetric process were made with known quantities of manganoso-manganic oxide (Mn_2O_4), the absolute purity of which was proved by repeated careful analyses, and also by comparison with the results obtained by carefully conducted gravimetric analyses. These test experiments are fully described in my paper, and I need not refer to the results further here than to say that they show that the volumetric process indicates the whole of the manganese present in any sample operated on. An experience of seven years, and repeated confirmations of the exactness of the method made during that time, still further

satisfy me that, when carefully conducted, the process yields absolutely correct results.

It is of course impossible for me to point out exactly how, in Mr. Atkinson's hands, the volumetric process has apparently failed to indicate the whole of the manganese supposed to be present; but a few particulars may be indicated which may probably account for the deficiency he has observed. In the first place, there is not sufficient evidence given to show that the sulphate of manganese used in his test experiments was not contaminated with alumina, lime, or some other base, which would be carried down with the manganese in the sodium carbonate and bromine-ammonia precipitations, and thus cause the gravimetric tests to indicate more manganese than the substance really contained. In my own experience I have recently had a well-crystallised sample of sulphate of manganese supplied to me as being pure, which was found to contain a notable quantity of sulphate of alumina. I would here point out that in Mr. Atkinson's paper there is obviously an error in the statement of the composition of the sulphate of manganese he used. The "manganese oxide (MnO)—23.61" there mentioned should, I presume, be "manganese—23.61" and the "sulphuric oxide (SO_3)—41.04" should be, I suppose, " SO_4 —41.04." The water given—35.35 per cent.—to make up the hundred parts is doubtless obtained by difference. Then, as tending towards deficiency in his volumetric test, if Mr. Atkinson added too much carbonate of lime to the solution before bromine was added, some of the iron would be precipitated as peroxide and carry down with it a small quantity of the manganese as protoxide. It is also possible that a somewhat large quantity of permanganate may have been formed in Mr. Atkinson's experiment which, being afterwards reduced by alcohol, would be precipitated in a lower form of oxidation than MnO_2 . When using bromine water it is difficult to see by the colour whether permanganate is formed or not. With solution of chloride of lime, which I always use, there is no such difficulty. When much permanganate is formed, the test should be rejected in very exact experiments, and a smaller quantity of chloride of lime used. But the formation of permanganate is altogether avoided and the subsequent addition of alcohol rendered unnecessary by the addition of some soluble salt of zinc, as well as iron, to the solution containing the manganese to be precipitated, and this is perhaps the safest plan to follow.

Since I have seen Mr. Atkinson's paper, I have again tested my method as applied to pure Mn_2O_4 . Two tests indicated respectively 99.96 and 100.07 per cent. of the manganese actually present. I know of no process of analysis which gives more exact results, and very few which give such exact results as this. In my opinion it would be as reasonable to revert to the precipitation methods for the determination of iron in iron ores as to return to the gravimetric methods of determining manganese in manganese ores.

But the testimony as to the accuracy of the volumetric process for determining manganese does not rest with me alone. Mr. Atkinson quotes Dr. C. R. Alder Wright's paper on the Oxides of Manganese as to the difficulty of obtaining pure peroxide of manganese; but he is perhaps not aware of the fact, as he does not mention it, that Dr. Wright and Mr. Menke have carefully investigated my process, and have confirmed its accuracy (see *Journal of the Chemical Society*, vol. xxxvii. pages 22 and 49). In Germany also Professor Ledebur has investigated the process, and he also confirms its accuracy. His results are published in the *Chemiker Zeitung* (vol.

viii. pages 910, 927, 963; translated and abstracted in the *Journal of the Iron and Steel Institute*, 1884, No. 1, page 269). According to this chemist, a sample of ferro-manganese which, by careful gravimetric analysis, was found to contain 46.22 per cent. of manganese, indicated 46.28 per cent. in each of two determinations by my process.

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Improvements in the Separation or Filtration of Solid and Liquid Matter. W. Hucks, London. Eng. Pat. 8162, July 6, 1885. 11d.

THE inventor constructs a filtering surface by making of filtering cloth an endless travelling band, which, at one point, is caused to pass into and out of a trough containing the liquid from which the suspended solid particles are to be removed. The arrangement is such that the torpid liquid can touch the upper side only of the inserted travelling cloth, the filtered or cleansed liquid passing through, whilst the solid particles are retained upon its surface. As the cloth continues to travel, the adhering solid matter is raised out of the filtering trough, and may then be successively pressed, treated chemically or otherwise, and finally removed, thereby leaving the cloth ready for the next operation without stoppage of any kind. Instead of the continuous movement, the cloth may receive a reciprocating or other convenient motion, the important point to be kept in view being that of providing for carrying on the operations of filtering, of cleansing the filtering surface, and of dealing with the deposit, continuously and simultaneously, without interfering the one with the other.—B.

Improvements in Preparing Milk of Lime, and in Apparatus to be used therefor, and for other such like Purposes. S. H. Johnson and C. C. Hutchinson, Stratford. Eng. Pat. 8623, July 16, 1885. 8d.

THE apparatus consists of a cylindrical vessel having a conical bottom, the interior provided with a perforated grating, a pipe for the admission of compressed air covered by a cone for the distribution of the air through the apparatus, and an outlet valve. The unslaked lime is put into the apparatus resting on the grating, the requisite quantity of water added, and the whole well agitated by compressed air. The clinker and unburnt stone remain on the grating and can be removed. The patentees claim that by this method and apparatus a concentrated milk of lime of even composition, free from inert matter, can be produced in a less time, with less power and with less wear and tear than by any other method.—C. C. H.

Improvements in Apparatus for effecting the Absorption of Gases or Vapours by Liquids. E. Edwards, London. From L. Rohrmann and M. Hiller, Germany. Eng. Pat. 8630, July 16, 1885. 8d.

THIS invention contemplates the absorption of gases by suitable liquids, through the passage of the gas over an extended surface of the liquid. The apparatus consists of a number of superposed flat trays ranged within a closed vessel. Each tray is sealed all round by a water joint, and has two small tubes projecting from the

* Any of these specifications may be obtained by post, by remitting the cost price, plus postage, to Mr. H. Reader LACK, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

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bottom, one constituting the overflow from the tray at a fixed level and dipping into the liquid of the next lower tray, the other forming the passage for the ascending gas. The tubes are placed alternately in successive trays. The liquid is admitted above, and, after having absorbed the gas, flows away from the lower part of the vessel, whilst the gas is admitted below, and ascends from tray to tray through the appointed tubes.—B.

Improvements in Metallic Drums for containing Chemical and other Substances. H. W. Todd, St. Helens. Eng. Pat. 9231, August 1, 1885. 6d.

GREATER rigidity and strength are given to metal drums by corrugations arranged circumferentially, and by corrugated V-shaped hoops over the ends.—G. H. B.

Improvements in Filters applicable for Caustic Soda Solution. W. P. Thompson, Liverpool. From Solvay & Co., Brussels. Eng. Pat. 8723, July 20, 1885. 8d.

THE filtration of lime residues in the manufacture of caustic soda has hitherto been performed through beds of limestone or flint, filtration through tissues having not been found practicable. This invention consists in the employment of asbestos or other mineral fibre, woven into sheets or webs, which is used in the following manner: A rectangular iron box has a bottom slightly curved or sloping downward to the point of exit. At this point a half-round collecting conduit with notched edges resting on the bottom collects the liquor which has passed through the filtering media. The lower part of the filter is protected by a lining of brick. Beds of broken inert mineral matter decreasing in size toward the top fill the lower part of the filter. The asbestos cloth is disposed in bands resting flat on the upper part of the finely-powdered mineral matter, consecutive bands overlapping each other. The joints rest on perfectly level beds of refractory bricks. The asbestos cloth is fastened to the edges by means of a movable iron frame which goes all round the filter. This frame does not rest directly upon the asbestos, but rests on perforated sheets of iron which cover the whole area of asbestos with the object of protecting the asbestos, and allowing the sediments to be cleared away without damaging the tissue.—S. H.

An Improvement in the Manufacture of Ice. Charles D. Abel, London. From C. Linde, Wiesbaden. Eng. Pat. 9612, August 12, 1885. 8d.

THIS invention relates to a new method of agitating the water in the moulds for the purpose of securing cleanness and transparency in slab ice formed in removable moulds placed vertically in a congealing liquid. The ends of the moulds are partitioned off, the partitions having numerous lateral perforations. The water is drawn away from one end of the mould, fresh water being admitted at the other end, thus causing a stream or horizontal movement and agitation of the water through the whole height of the mould, with the effect of retaining the transparency of the water on freezing. Instead of partitions, perforated pipes may be employed. The ends of the blocks of ice, which are imperfectly formed, are cut off when the slab is removed from the mould.—B.

II.—FUEL, GAS, AND LIGHT.

Improvements in Making and Utilising Water and Oil Gas. C. J. C. Bailey, Fulham, and S. C. Dean, Fulham. Eng. Pat. 7457, March 1, 1886. 6d.

THIS invention consists in utilising the heat said to be at present wasted in the walls and roofs of furnaces and kilns by constructing these walls with flues or channels, which serve for the production of water gas by the decomposition of steam.—A. R. D.

Improvements in the Means of Generating Fired Gases for Illuminating, Heating, and Metallurgical Purposes. T. S. Lindsay, London. Eng. Pat. 6938, March 8, 1886. 1s. 1d.

THIS is a process for superheating steam, mixing it with liquid hydrocarbon, and subjecting the mixture to a further heating process to "fix" it. The superheating and fixing is performed by passing the steam or mixed gases through a heated retort, packed with cones, the apex of one being within the interior of the next. The cones have each a flanged base, fitting the interior of the retort, and this flange is perforated for the passage of the gas. By this arrangement, the gas is forced to pass in close contact with the heating surface of the retort, and being also continually broken up by passing through the small flange apertures, is thereby conveniently superheated and rendered perfectly homogeneous. The resulting product is a gas that can be conveyed for any practical distance without fear of condensation.—A. R. D.

Improvements in the Method of Illuminating by means of the Incandescence of Refractory Substances. O. Palmehjelm, Stockholm. Eng. Pat. 7573, March 19, 1886. 11d.

THIS invention consists of improvements in the details of the system of lighting for which Letters Patent No. 5646 of 1883 were granted. The specification and drawings describe various constructions of incandescence bodies, with arrangements for suspending these in the flame of a water-gas burner.—A. R. D.

A New or Improved Apparatus for Purifying and Enriching Coal-gas. A. Dempster, Elland, Yorks. Eng. Pat. 4099, March 24, 1886. 6d.

ON its way to the ordinary purifiers the gas passes through a chamber subdivided by vertical perforated plates reaching nearly to the bottom, and, impinging upon these plates, deposits a large quantity of tarry matter which overflows into another chamber or carburetter placed beneath. This lower chamber is provided with a steam coil to keep the tar warm, and with a pipe perforated with small holes for passing jets of warm air through the oils floating on the surface of the tar. The warm air for this coil is heated by being driven into a separate chamber, partly filled with tar, kept at the requisite temperature by a steam pipe immersed therein. The air thus impregnated with volatile hydrocarbons rises into the chamber above, and mixes with the other gas going forward to the purifiers. The air orifices in the carburetter are covered with caps, which cause the air to pass downwards and be distributed before rising upward through the floating oils.—A. R. D.

Improvements in Processes of and Apparatus for Manufacturing Gas. B. Loomis, Hartford, Connecticut, U.S.A. Eng. Pat. 4469, March 30, 1886. 1s. 3d.

THIS is practically a continuous process for making gas of any desired illuminating power. The apparatus consists mainly of two generating chambers and two superheating and fixing chambers. These latter are so divided by transverse vertical partitions of fire-brick as to form one long length of flue space. In working the plant air is forced downwards through the fuel in each generator, and the products of combustion, supplied with air by suitable arrangements, pass through the fixing chambers and away under a steam boiler. When all is heated to the requisite degree, the air supply is entirely cut off, and superheated steam is passed into fixing chamber No. 1, whence it finds its way upwards through the fuel in generator No. 1, and is thereby decomposed. The mixed gases next travel downwards through the fuel in generator No. 2, where the decomposition is completed, and finally pass through fixing chamber No. 2, where oil is added to produce the required illuminating power, and where perfect homogeneousness is effected. When the temperature has fallen below the point required

for decomposing and fixing, the process of heating up is again performed and is followed by the production of gas as before. For details of the apparatus the Blue Book must be consulted.—A. R. D.

An Improved Artificial Fuel. H. H. Lake, London. From Leon Cline, Chicago. Eng. Pat. 5024, April 10, 1886. 4d.

THREE parts of ground charcoal are mixed with one part of ground charred cork. When required for disinfecting, one-hundredth part of chloride of lime is added. This fuel burns downward from the top, and is applicable wherever a slow moderate heat is required.—A. R. D.

The Relative Calorific Effects of Tar (with and without Steam) and Coke for Retort Firing. F. G. Dexter. Proc. Gas Institute. J. Gas Lighting, June 29, 1886, 1242–1244.

FOR the relative heating values of the substances under consideration, the numbers given by Favre and Silbermann are taken. These are:—Hydrogen = 34,462 cal., carbon 7770 cal., coke (desiccated) 7000 cal., and carbonic oxide 2400 cal. To obtain the relative calorific value of tar and coke, the author classified the constituents of tar according to their respective boiling points under the different periods of distillation and took the average formulae of the hydrocarbons coming under these

It will be seen that the latent heat of the steam produced is deducted from the heat of combustion in each case. In the case of combustion in the furnace this is necessary as the steam escapes in a highly attenuated state and carries its latent heat with it. The high specific heat of steam, its latent heat, and the fact that the weight of the products of combustion is about three times greater, serve to reduce the calorific intensity of hydrogen to practically the same as carbon, a question of considerable importance in furnaces where very high heats are required. The relative calorific intensities of tar and coke are as follows:—

Coke .. $5250 - 134 = 5116 \div 2.42 = 2114$ C. calorific intensity.
Tar .. $8550 - 291 = 8256 \div 3.32 = 2486$ C. " "

The practical heating value of tar is therefore due in great measure to its form and ease of manipulation. It can be introduced in a small constant quantity, and in a condition much more favourable for intimate mixture with the supply of air than is possible with coke, and as a consequence the excess of air supply required is much less, the intermittent cooling effect produced by fresh charges of coke is avoided, and the carbon being burnt to carbonic anhydride a much higher heating effect is necessarily produced. The use of steam with tar should be avoided if possible, as it tends to reduce the temperature in the furnace.—D. B.

CONSTITUENTS.	Average Formula.	Weight per cent.	Boiling Points.	Proportionate Weight of Constituents.		Calorific Value.	
				Carbon.	Hydrogen.	Carbon (Units).	Hydrogen (Units).
First Runnings	C_9H_{10}	3.0	up to 110°	.025714	.004286	260	148
Light Oil	$C_{11}H_{14}$	7.0	110 to 210	.061091	.008910	474	307
Middle Oils	$C_{13}H_{18}$	27.0	210 to 270	.237073	.032927	1842	1145
Heavy Oils	$C_{14}H_{18}$	7.0	240 to 270 and upwards	.063913	.006087	497	210
Pitch (56 p.c.), composed of—							
Oils	C_7H_{10}	17.5	360° and upwards	.166336	.008663	1292	298
Carbon	C	27.5	—	.275000	—	2137	—
Gases and Water	—	11.0	—	—	—	—	—
				.829127	.060873	6442	2108
Total				0.89		8550	

divisions as representing the constitution of the oils obtained. The results are shown in the above table.

Coke when drawn from the retort and slaked contains fully 25 per cent. of water in addition to ash and sulphur. By disregarding these impurities and deducting merely 25 per cent. for water from the value of desiccated coke, we obtain $0.75 \times 7000 = 5250$ units per pound of coke, or a relative heating value of coke and tar as 5:8. It is necessary, however, to take into account the amount of heat absorbed by the products of combustion, which, considering the nature of the fuel, is necessarily very different. This alters the ratio to 1:2 as illustrated by the following tables, in which the temperature of the gases leaving the retort setting is taken at 1082° :—

PRODUCTS OF COMBUSTION OF LB. OF COKE.

Specific Heat.

2.75lb. $CO_2 \times 0.2163 = 0.5948$ unit.

7.00lb. N $\times 0.2438 = 1.7066$ " (latent heat 291 units).

0.25lb. $H_2O \times 0.4805 = 0.1201$ " (latent heat = 134 units).

2.4215 " calorific value.

Then $5250 - 134 = 5116 - 1082 \times 2.42 = 2198$ units for coke.

PRODUCTS OF COMBUSTION OF LB. OF TAR.

Specific Heat.

3.400lb. $CO_2 \times 0.2163 = 0.73542$ unit.

0.547lb. $H_2O \times 0.4805 = 0.262392$ " (latent heat 291 units).

9.702lb. N $\times 0.2438 = 2.36544$ "

3.32178 " calorific value.

Then $8550 - 291 = 8256 - 1082 \times 3.32 = 4664$ units for tar.

On the Application of Tar and Breeze to Retort Furnace Firing. Proc. Gas Institute. W. R. Jones. J. Gas Lighting, June 29, 1886, 1241.

DIFFERENT systems have been employed for burning tar, one of the earliest consisting in allowing it to run on an iron shoot, which discharges it on to the coke fire. A modification of this system has been in use for many years on the Continent. It consists of a sloping table of fire tiles with an opening at the back through which any deposit is removed, and by which a supply of air is obtained. This arrangement may be applied to ordinary furnaces by removing the fire doors and furnace bars. Briquettes formed of tar and coke dust are also used as fuel on the Continent. In some cases tar and coke dust are mixed on the floor of the retort house and thrown on the coke fire. Where briquettes are used pitch must be employed to give the material the necessary degree of adhesion, 10 per cent. of pitch to 1 per cent. of breeze being the proportion usually required. As breeze contains much earthy matter and but little carbon, it is best to burn it in regenerative furnaces on account of the high heat attainable therein. The consumption of fuel in generator furnaces varies between 18 and 30 per cent. of the quantity of coal carbonised, whilst regenerators, for instance Siemens' regenerative furnaces, consume only 16 per cent. of fuel. According to Ellissen's experiments on the Didier settings of six retorts (regenerators), the consumption of fuel is 15.94 per cent.; Didier's settings of nine retorts burn 14.26 per cent., and Schilling's

settings of nine retorts burn 13.54 per cent. The author has constructed a generator furnace consuming 14 per cent. of fuel calculated on the quantity of coal carbonised. The system consists in the production of a deep fire in the "high temperature furnace." Fire bars are not required, the hearth floor contains two openings, and a second fire or "low temperature furnace" is used, which is caused by the hot scoria and small fuel falling through the openings. This second fire heats all the air introduced through the lower fire bars, which afterwards passes through the openings into the high temperature furnace, where the combustion is completed.—D. B.

A Recent Experience with Purification by Oxide of Iron.
T. Travers (Proc. of the Gas Institute). J. Gas Lighting, June 29, 1886, 1252.

SEVERAL trials have been made for the purpose of re-oxidising the spent oxide in the purifiers, but the results have hitherto been without success, the problem to be solved being how to effect the revivification so as not to cause a heating in the vessels or injury to the illuminating power of the gas. A process has been patented by J. G. Hawkins, in which carburetted air is supplied to the oxide in the purifiers, the patentee claiming that by this means the spent material can be reoxidised without difficulty. The author has tried this method at the Cork Gas Works. The apparatus consists of the following parts:—(1) A small steam engine and air pump; (2) a carburetter, which consists of a horizontal box about 12ft. long and 18in. by 12in., in which is laid a steam coil. The tar to be used for carburetting purposes enters at one end of the box, and is made to pass to the other end by zigzag partitions. It is thus kept for a long period in contact with the steam coil and maintained at 170°, at which temperature the lighter hydrocarbons are given off. These are taken up by the air drawn in by the pump and passing through the meter and carburetter. The outlet from the carburetter is connected to the inlet of the purifier. The saving in labour may be estimated from the fact that for three months the purifiers were changed four times, whilst with the ordinary process eleven changes were made during the same period. About five gallons of tar per ton of coal are used. As the tar enters the carburetter it has a sp. gr. of 1.196, which is increased to 1.218 as it leaves the vessel. The illuminating power of gas is tested regularly twice every day at the company's office, situated about one mile from the works. The gas purified in the ordinary manner showed an average illuminating power of 16.49 candles for three months, and the gas made by the new process showed an average of 16.55 candles for a similar period.—D. B.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Improvements in the Treatment of Carbonaceous, Bituminous, Calcareous, and other Substances, such as Ores, in order to Obtain Products therefrom. Henry Aitken, Falkirk, N.B. Eng. Pat. 6048, May 16, 1885. 8d.

INTO retorts, which are heated externally, or into chambers, or gas-producers, heated by the combustion of a portion of the charge, air, steam, or gas (or mixtures of these) are introduced at different levels, for the purpose of regulating the temperature and the combustion of the material under treatment—the precise arrangements depending upon the purpose to be accomplished in the distillation.—W. G. M.

Improvements in and Apparatus for obtaining Carbolic Acid and other Tar Acids from Tar Oils. J. Hardman, Milton. Eng. Pat. 7079, June 10, 1885. 8d.

TAR oils are treated with a solution of caustic soda, and the alkaline phenates, cresylates, and other compounds thus formed are allowed to run slowly down a tower

filled with stones, coke, or other suitable material. In this tower the solution meets an ascending stream of carbonic anhydride, a mixture of sodium carbonate, carbolic, cresylic and higher boiling tar acids being obtained. On reaching the base of the tower, the mixed solutions are run into the ordinary separating tanks. The carbonic anhydride is obtained from the waste gases formed in the manufacture of ammonium sulphate. The gases are cooled, the sulphuretted hydrogen extracted by means of iron oxide, and the remaining gases, representing almost pure carbonic anhydride, are allowed to pass up the tower. The solution of sodium carbonate is reacidified with lime, the solution of caustic soda obtained being used for extracting a further quantity of tar acids from tar oils. This solution contains from 2 to 3 per cent. of tar acids, which in the ordinary process of decomposing the alkaline phenates by means of sulphuric acid would be lost by being run off with the waste sodium sulphate liquors.—D. B.

The Utilisation of Residual Products in Gas Works.
J. T. Lewis (Proc. of the Gas Institute). J. Gas Lighting, June 29, 1886, 1247—1252.

IN discussing the utilisation of coke, the author refers to the advantages gained in supplying broken coke. He shows that the sale of coke is increased by this means, hence the average price realised per ton is greater. The reason for this is that broken coke is applicable for many purposes that large coke is not, such, for instance, as kitchen ranges, slow combustion stoves, smiths' forges, etc. The cost of breaking coke is about 8d. per ton, and to this it is necessary to add the difference in the value of dust made in breaking, which is about 4d., making a total cost of 1s. per ton. The extra price obtained for broken over large coke is about 2s. per ton. As regards the value of coal-tar the author shows that in 1883 the price varied between 1s. 8d. and 3s. 4d. per ton of coal carbonised, whilst at the present time tar is only worth from 4d. to 7d. The following figures give the value of tar to tar distillers, taking the prices of the different products at the present market value. The statements have been obtained from two sources, one distiller carrying the process further than the other:—

PRODUCTS FROM ONE STILL OF EIGHT TONS OF TAR.

		£	s.	d.
Naphtha	60 gallons at 9d. per gallon	2	5	0
Light oil	60 " 3d. "	0	15	0
Cresote	500 " 0½d. "	1	11	3
Anthracene	1 cwt.	1	11	8
Pitch	5 tons at 15s. per ton	3	15	0

	£	s.	d.
Wages on the above	2	0	0
Coals	0	6	0

Wear and tear, rent, etc., not known

Giving value of 1 ton as nearly 19s.

PRODUCTS FROM ONE TON OF TAR.

		£	s.	d.
Benzene (50.90)	5 gallons at 1s. 5d. per gallon	0	7	1
Naphtha	2 " 9d. "	0	1	6
Carbolic acid	5 " 1s. 8d. "	0	8	4
Cresote oil	50 " 0½d. "	0	3	1½
Anthracene	30lb. of 35 per cent.	0	8	0
Naphthalene	2 cwt. at 3s.	0	6	0
Pitch	11 cwt. at 9d.	0	8	3

	£	s.	d.
Sulphuric acid, caustic soda, slack, and labour for working	0	10	6
Wear and tear, rent, etc., not known	—		

£1 12 9½

These statements show that tar is not at the present time very valuable to tar distillers for the purpose of distillation. Where the annual quantity of coal carbonised is below 30,000 tons the distillation is said to be unremunerative. In considering the utilisation of tar as a fuel the author gives the following particulars illustrat-

ing the varying values of coke and tar in different localities:—

(1) Cost of coke for one furnace per 12 hours.....	£0 7 4
Cost of coke and tar for ditto	0 5 2

Saving£0 2 2

Showing a saving of 4s. 4d. for each furnace per 24 hours.

(2) Coke saved in 24 hours, 1 ton	£0 16 8
Tar used, 90 gallons at 1½d. per gallon	0 3 9

Showing a saving of 12s. 11d. per 24 hours. Tar equal as fuel up to 2d. per gallon.

(3) Coke saved, 13cwt. at 4d. in 24 hours	£0 4 4
Tar used, 68 gallons at 10s. per ton	0 3 5

Showing a saving of 11d. for each furnace for 24 hours. Tar value 12s. 9d. per ton.

When coke is selling at 5s. per ton, and tar at 7s., one can be sold as profitably as the other; but in the majority of cases it will pay better to sell coke than tar. The manufacture of asphalt from tar is carried on in some gas works with considerable profit, and if more generally adopted by gas works would prove not only a source of direct profit, but would be remunerative indirectly through the reduced quantity of tar for other purposes. Another method in which tar might be more extensively used is for the manufacture of patent fuel. The immense quantity of coke dust in some of the largest gas works, as well as the breeze, can be profitably converted into fuel by the admixture of tar or soft pitch. At the Dover Gas Works patent fuel was manufactured in the following proportions:—

	Tons.	Cwt.	Qr.	Lb.	£	s.	d.
1 chaldron of breeze at 2s. 6d.	1	1	2	7	0	2	6
40 gallons of tar at 3d.	0	4	1	11	0	10	0
Labour for working					0	1	8
Coke as fuel					0	0	8
	1	5	3	18	0	11	10

The cost of the manufacture was 11s. 4d. per ton, with tar at 3d. per gallon. This fuel was used in the re-ort furnaces and steam boilers, and is said to last double the length of time that coke does for this purpose. In conclusion the author discusses the utilisation of ammoniacal liquor by converting it into ammonium sulphate.—D. B.

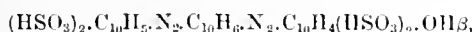
IV.—COLOURING MATTERS AND DYES.

Improved Manufacture of Ink from Waste Dye-liquors. T. Frusher, Trowbridge. Eng. Pat. 8241, July 7, 1885. 4d.

SPENT liquors of bichromate of potash or soda and logwood are boiled together for a few hours to produce the ink.—G. H. B.

The Production of New Azo-colours. Meinhard Hoffman and Arthur Weinberg, Mainkur, Frankfurt-on-Main, Germany. Eng. Pat. 9214, July 31, 1885. 4d.

THESE COLOURS are produced by the action of diazo-sulphonic acids upon α -naphthylamine, the diazotising of the amido-azosulphonic acid and the combination of the tetrazo-compound with phenols and their sulphonic acids. The new colours are thus diazo-azo-compounds. As an example the inventor gives the following: α -naphthyl-aminedisulphonic acid is diazotised and combined with α -naphthylamine and the violet colouring matter again diazotised and allowed to act upon an ammoniacal solution of β -naphtholdisulphonic acid. The secondary azo-colouring matter, which has the formula



is salted out, collected and dried. Other α - or β -sulphonic acids may be used instead of the disulphonic acid of α -naphthylamine and mono- or di-sulphonic acids of the

naphthols or the unsulphonated naphthols. The colouring matters obtained are said to vary from reddish violet to dark blue.—R. M.

A New Manufacture of Violet and Blue Azo-dyes. Herbert John Haddan, 67, Strand, Westminster. From the "Farbenfabriken vorm. Bayer & Co.," Elberfeld, Germany. Eng. Pat. 9510, August 10, 1885. 6d.

THE colouring matters here described are obtained by combining tetrazoditoly with the naphthols or their sulphonic acids. The tolidine may be obtained by the alkaline reduction of ortho- or para-nitrotoluene or a mixture of the two. The colours are described as being acid proof and applicable to unmoirated cotton in a slightly alkaline bath, whereas the corresponding dyes from benzidine are said to be only suitable for wool, and are moreover dull and not fast. The chief compounds claimed are those obtained from α -naphtholmonosulphonic acid (blue), β -naphthol- α -sulphonic acid (Bordeaux), Schaeffer's β -naphtholmonosulphonic acid (blue violet), β -naphthol-disulphonic acid (R salt, reddish blue; G salt, dull blue) and α - and β -naphthol, blue or violet compounds insoluble in water. The colours are formed in the usual way by diazotising the base and adding it to the alkaline solution of the naphthol or sulphonic acid.—R. M.

Improvements in the Manufacture of Yellow and Orange Colouring Matters suitable for Dyeing and Printing from Dioxytartaric (Carboxytartaric) Acid. John Henry Johnson, 47, Lincoln's Inn Fields, London. From the "Badische Anilin und Soda Fabrik," Ludwigshafen-on-Rhine, Germany. Eng. Pat. 9858, August 19, 1885. 6d.

THE patentees claim a new class of colouring matters formed by the action of phenylhydrazine or its sulpho-derivatives, or other primary hydrazines upon the dioxytartaric acid. On adding the primary hydrazine to an acid solution of the dioxytartaric acid, a reaction gradually takes place in two stages, the first step being the formation of a condensation product between one molecule of each of the constituents, this product possessing little or no colouring property. The next phase of the reaction is the formation of yellow or orange colouring matters produced by the condensation of the first product with another molecule of the hydrazine. The colouring matters generally separate out spontaneously, and can be filtered off: when they have a tendency to remain in solution, sodium carbonate and common salt effect the precipitation of the dye. The three following examples illustrate the working of the process:—(1) Phenylhydrazine hydrochloride is mixed with the necessary quantity of the sodium salt of dioxytartaric acid dissolved in cold water and previously acidulated with hydrochloric acid. The reaction may be assisted by a gentle heat, and is complete in about 12 hours. The resulting colouring matter is but sparingly soluble in cold water, but readily soluble in alcohol or alkalis. Similar compounds are produced by the homologues of phenylhydrazine and α -naphthylhydrazine. (2) The solution of the acid is in this case mixed with a solution of the sodium salt of phenylhydrazine-para-sulphonic acid, and the mixture kept at 80° C. for 1 hour and about 12 hours at the ordinary temperature. The colouring matter is filtered and purified by solution in sodium carbonate, filtration and reprecipitation by common salt. The product, termed "tartrazine," is soluble in water, and dyes animal fibre with acids or acid mordants a fast golden yellow. Similar products are obtained from the isomerides and homologues of the hydrazine-sulphonic acid. (3) In this example mixed products are obtained by the successive action of different hydrazine-compounds upon the dioxytartaric acid. The inventors consider that "tartrazine" is the most useful of the compounds described in the specification. The dioxytartaric acid was first obtained from tartaric acid by Kekulé (*Ann. der Chemie*, vol. 221, p. 245).—R. M.

Improvements in the Manufacture of Azo-dyes. James Yate Johnson, 47, Lincoln's Inn Fields, London. From the "Farbenfabriken vorm. Friedrich Bayer & Co.," Elberfeld, Germany. Eng. Pat. 14,424, November 24, 1885. 6d.

THESE colouring matters are produced by the combination of tetrazo-compounds of alkyl-ethers of diamidodiphenol and its homologues upon phenols or amines and their sulphonic acids. The amido-ethers are prepared by the alkaline reduction of nitrophenol and nitroresol ethers, and the subsequent intra-molecular transformation of the hydrazo compounds. As examples, the following compounds are described:—(1) By the action of tetrazo-dianisole or tetrazo-diphenetol upon α -naphthol-monosulphonic acid in alkaline solution, an acid-proof blue dye is obtained which is greener than the "azo-blue" obtained from diazotised tolidine and dyes unmordanted cotton from an alkaline bath. (2) The foregoing tetrazo-compounds are combined with β -naphthylamine- β -monosulphonic acid in the presence of acetic acid, and after the formation of the colour is complete the solution is neutralised with alkali. The colour, when purified, dyes cotton from an alkaline bath of a fine bluish-red colour. In the foregoing processes one molecule of the tetrazo-compound is combined with two molecules of the phenol or amine. It is possible, however, to form the secondary azo-compound in two stages by acting upon the tetrazo-compound first with one molecule of a phenol, amine, etc., and then with another dissimilar phenol or amine so as to produce a mixed secondary azo-compound. The following examples illustrate this production of mixed azo-dyes:—(1) Diamidodianisidine is converted into its tetrazo-salt in the usual way and combined with one molecule of α -naphthylamine-monosulphonic acid. A brown intermediate product is formed which is then combined with another molecule of α -naphthylamine. The colour thus formed dyes cotton of a deep bluish red. (2) A reddish blue is similarly obtained by combining the tetrazo-compound, first with one molecule of β -naphthylamine-monosulphonic acid and then with a molecule of α - or β -naphthol or their sulphonic acids. (3) Greenish blue dyes are obtained by combining the tetrazo-compound first with α -naphthol and then with the sulphonic acids of α -naphthol. (4) Reddish-yellow dyes are obtained by combining the tetrazo-compound, first with sulphanilic and then with salicylic acid. A list of the phenols, amines, sulphonic and carboxylic acids claimed is given in the specification.

—R. M.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

An Improved Process for Removing Resinous, Gummy and Oily Matter from Fibrous, Spun or Woven Materials. B. Fiegl, Berlin. Eng. Pat. 4323, March 27, 1886. 4d.

AN improved isolation process for the preparation of spinning fibres, spinning material, spun and woven goods of all kinds, by the action and use of pepsin or pancreas as set forth.—H. A. R.

VII.—ACIDS, ALKALIS, AND SALTS.

Improvements in Apparatus for Burning or Calcining Ores and Minerals containing Sulphur or Arsenic, for the Manufacture of Sulphuric Acid, or Arsenious Acid, or White Arsenic. Robert Oxlard, Plymouth, and Charles Oxlard, Sydenham. Eng. Pat. 7285, June 15, 1885. 8d.

THIS is a modification of Oxlard and Hocking's calciner (Eng. Pat. 2950, 1868), so arranged that the gaseous products of calcination shall pass to the condensers unmixed with burnt gases from the heating furnace. At the lower end of the rotating calcining tube is a cast-iron prolongation, heated externally by a grate beneath, and a system of flues around it. The amount of air necessary to the calcination of the ore is admitted by a regulator in the end plate of the prolongation, which

is also fitted with a door for the removal of the calcined material. When the calcination is once fairly started, but little extraneous heat is necessary for complete roasting.—W. G. M.

Improvements in the Manufacture of Peroxide of Barium, and its use in Making Oxygenated Water for Bleaching, or for other Purposes. Arthur Brin, Paris. Eng. Pat. 7867, June 29, 1885. 6d.

CAUSTIC BARYTA is produced by heating the nitrate, and a partial vacuum is afterwards employed to remove nitrous vapours. Then oxygen or air, freed from moisture and carbonic acid, is passed over the baryta at a suitable temperature, preferably under pressure. The barium peroxide thus formed is dissolved in acidulated water for use.—G. H. B.

Improvements in the Manufacture of Hydrate, Sulphate and other Salts of Alumina. H. Richardson, Jarrow-on-Tyne. Eng. Pat. 8382, July 11, 1885. 4d.

BAUXITE, blast-furnace slag or other substances containing alumina are treated with hydrochloric acid until alumina, together with iron, lime and other bases are dissolved. After separating the insoluble matter, a sufficient quantity of any reducing agent, such as sodium sulphite or hyposulphite, is added to the clear solution, for the purpose of reducing the iron to ferrous chloride. The liquor is then treated with milk of chalk, when aluminium hydrate is precipitated, iron and lime remaining in solution. The precipitate is separated and well washed with water. The aluminium hydrate may be dried and used as such, or dissolved in acids for the manufacture of the different salts of alumina.—S. H.

An Improved Process for the Production of Carbonate of Potassium from Chloride of Potassium or Sulphate of Potassium. F. Brünjes, Strassfurt, Germany. Eng. Pat. 8993, July 25, 1885. 6d.

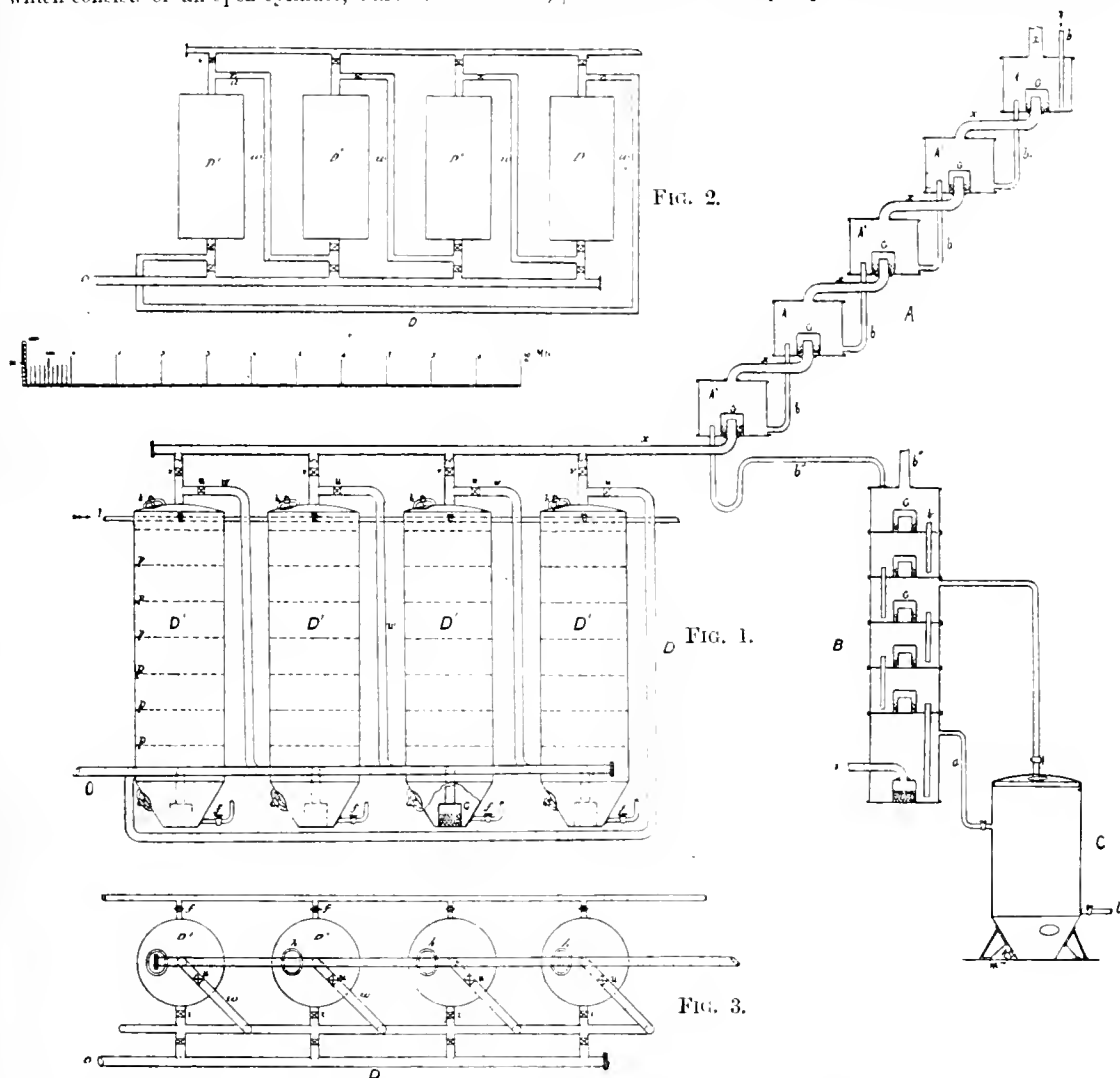
CARBONIC ACID and ammonia or ammonium carbonate is conducted into a solution of a magnesium salt, into magnesia or magnesium carbonate in suspension, and after some time the double salt of ammonium-magnesium carbonate ($MgCO_3 + (NH_4)_2CO_3 + 4H_2O$) separate out. This double salt is mixed with potassium chloride or sulphate and as much water as will dissolve the said salts. This solution, after standing for six hours, is treated with carbonic acid. After some time crystals of magnesium-potassium carbonate are deposited, whilst ammonium chloride or sulphate passes into solution. This double salt is decomposed with water, magnesium carbonate remaining behind, and is used again in the first stage of the process. The operations for the production of ammonium-magnesium carbonate, and the conversion of the same into potassium-magnesium carbonate may be combined by, for example, finally conducting ammonium carbonate and carbonic acid into a solution of carnallite or into a solution of potassium-magnesium sulphate or into magnesia or magnesium carbonate in suspension, potassium chloride being afterwards added and carbonic acid passed through the solution. In this way crystals are obtained which yield, by the decomposition with water, a solution of potassium carbonate and a precipitate of magnesium carbonate.—S. H.

An Improved Method of Manufacturing Soda Crystals and Caustic Soda direct from the Bicarbonate resulting from the Ammonia Soda Process, and Recovery of Ammonia and Carbonic Acid, and Apparatus employed therefor. F. B. Cheesbrough, Liverpool. From J. Hawliczek, Vienna. Eng. Pat. 9425, August 7, 1885. 8d.

THE sodium bicarbonate obtained by the ammonia soda process is mixed with water and heated to boiling point, at which temperature it is retained until its partial decomposition to mono-carbonate takes place, which under the best circumstances reaches 40 per cent. For the complete decomposition an increased pressure of steam is employed, a strong agitation of the soda liquor

being kept up at the same time, which has a marked influence on the entire expulsion of the carbonic acid and ammonia in the liquor. The liquor thus obtained is generally of a greenish colour, arising from tarry matters. By using such oxidising agents as free chlorine or a solution of chlorine in water, the tar pigments are destroyed, and a clear liquor yielding white crystals is obtained. The apparatus for carrying out this process consists of a cylindrical vessel with a conical bottom. A cast-iron bell, the edge of which is serrated, facilitates the even distribution of steam, which is supplied under the bell from a steam pipe. The vessel is provided with a central shaft which runs in a footstep on the top of the steam distributor, the other end of the shaft passing through a stuffing box. This shaft carries the agitator, which consists of an open cylinder, flared at both ends,

cess. The brine enters the apparatus through the pipe *b* (Figs. 1, 2 and 3) of the top compartment of A, which consists of a set of cylinders. It leaves them by another pipe *b'* of a higher level, so that there is always a layer of brine at the bottom of the cylinders, which is used for washing the carbonic acid and other gases not absorbed in the apparatus D, in order to retain the last traces of ammonia. The brine then flows into B, another set of cylinders used for absorbing the ammonia entering by the pipe *S* into the brine. The brine thus ammoniated leaves B through the pipe *a*, and passes into the settling vessel C, where, after settling, the clear liquor is pumped through the pipe *l* into the carbonising cylinders D. These vessels consist of a cylindrical and a conical part. The former contains perforated plates *p* for distributing the carbonic acid pumped into it through *o*, and dis-



on the outside of which is a spiral blade with a right-hand pitch, and on the inside a spiral blade with a left-hand pitch. The carbonic acid, ammonia and steam are led by a pipe to a condensing apparatus, where the ammonia is obtained in solution and the carbonic acid passed on for further use.—S. H.

Improvements in Apparatus for Making Bicarbonate of Sodium. T. Capper, Northwich. From S. Pick, Szcakowa, Austria. Eng. Pat. 7831, June 27, 1885. 11d.

THIS invention relates to improvements in plant for making sodium bicarbonate by the ammonia soda pro-

cess. Salt rests on the highest perforated plate, and the ammoniated brine entering through pipe *l* is compelled to pass through the salt and dissolve it. Whilst one vessel D is filled with salt, the rest is saturated with carbonic acid, which passes from the bottom upwards through the liquor and the perforated plates, and leaves through the pipe *ic* in order to ascend the next vessel in the series, and so forth until, after being deprived of the greatest part of the carbonic acid, it travels into A, to be washed free from ammonia. When the saturation of the ammoniated brine has gone far enough, its liquor, containing ammonium chloride and sodium bicarbonate in suspension, is run out by the tap *g*, and the latter separated

from the former in any convenient manner. The ammonia from the ammonium chloride is regenerated in the apparatus shown in Fig. 4. The liquor is passed into E through the pipe *g*, it drops on a plate *pl*, which rests on another plate *g'*, having a large hole in the centre to allow steam to go upwards and the liquor to pass downwards. The lowest compartment of E contains a cap G, and an overflow pipe *g'*, through which the liquor, freed from volatile ammonia compounds, runs into the highest compartment of the apparatus F. Here it meets with milk of lime which enters at *m l*. The liquor gradually descends the apparatus F, meeting steam and giving off its ammonia, until it is exhausted, when it is run to waste by means of the pipe *s t*. The ammonia leaves at the top at *s*, to pass into the bottom compartment of B (Fig. 1).—S. II.

Improvements in obtaining Chlorides of Barium and Strontium. J. Mactear, London. Eng. Pat. 1915, February 10, 1886. 4d.

BARIUM (or strontium) sulphate and calcium chloride, mixed with charcoal or other suitable carbon, and a little lime or limestone, are strongly heated in a furnace, the waste fire-gases of which are utilised for drying the calcium chloride. The resulting product consists of barium (or strontium) chloride and calcium sulphide or oxysulphide, and by lixiviation yields barium (or strontium) chloride free from sulphides.—S. II.

Improvements in the Manufacture of Hydrates of Strontia and of Baryta. J. Mactear, London. Eng. Pat. 5170, April 14, 1886. 4d.

STRONTIUM (or barium) sulphate is mixed with rather more than the equivalent quantity of sodium sulphate, and also with carbonaceous or other reducing matter. This mixture is heated in a furnace in order to reduce the sulphates to sulphides. The resulting mass is dissolved in hot water and strontium (or barium) hydrate

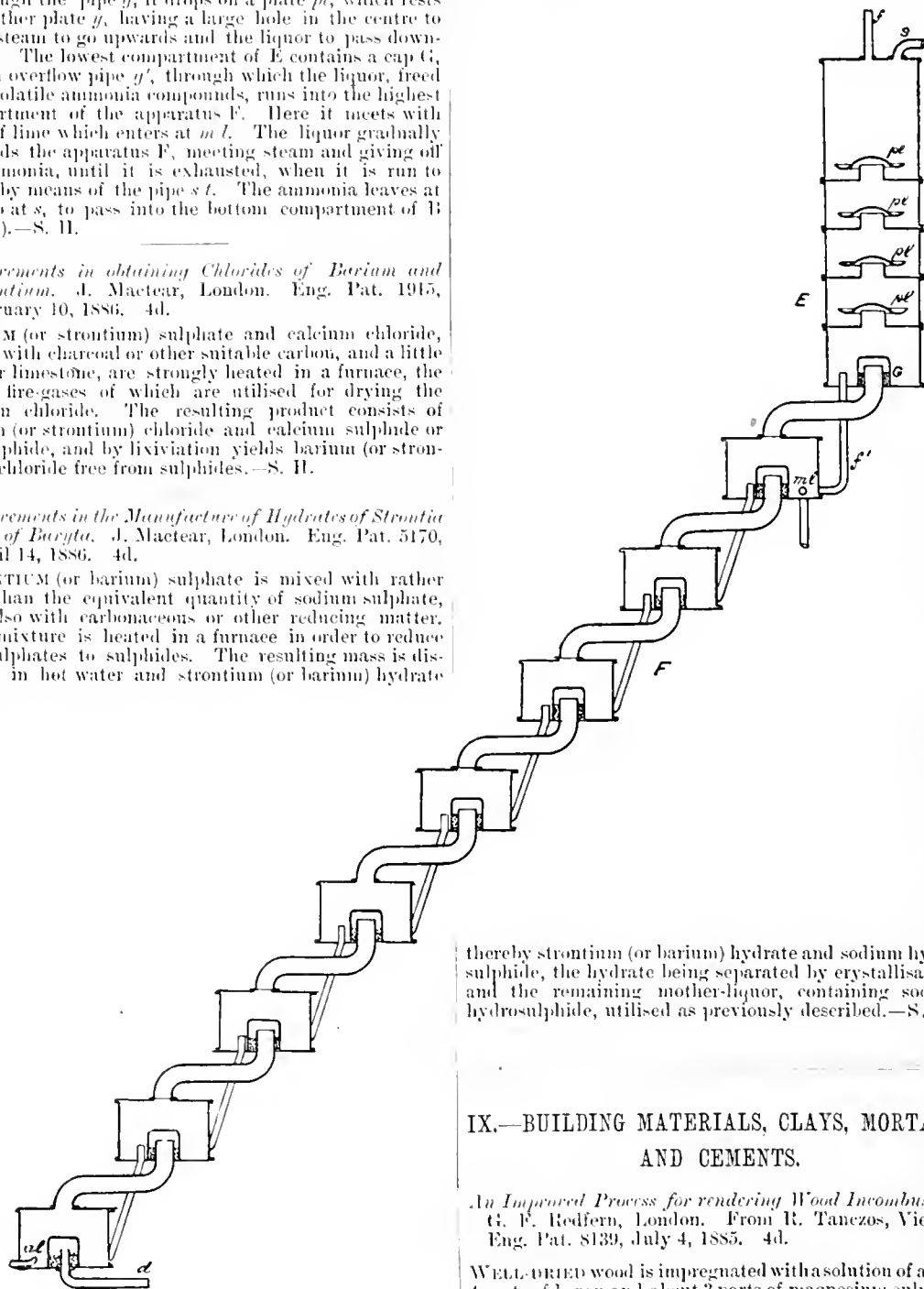


FIG. 4.

crystallised out. By this treatment the sodium salt is converted into sodium hydrosulphide, which remains in the mother-liquor, and after boiling down may be used with carbonaceous matter for reducing another batch of strontium (or barium) sulphate. In the usual process of manufacturing strontium (or barium) hydrate the strontium (or barium) sulphide is split up by solution into

hydrate and hydrosulphide, which latter becomes a by-product. By this process this by-product may be utilised by mixing it with sodium sulphide solution, obtaining

thereby strontium (or barium) hydrate and sodium hydrosulphide, the hydrate being separated by crystallisation, and the remaining mother-liquor, containing sodium hydrosulphide, utilised as previously described.—S. II.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

An Improved Process for rendering Wood Incombustible G. F. Redfern, London. From R. Tanczos, Vienna. Eng. Pat. 8139, July 4, 1885. 4d.

WELL-DRIED wood is impregnated with a solution of about 4 parts of borax and about 3 parts of magnesium sulphate in about 20 parts of hot water. It is then coated with a mixture of washed clay and a sufficient quantity of liquid silicate of soda to enable the mass to be applied by means of a paint brush. After drying the wood is covered with paper or linen previously impregnated with the above solutions. Finally the whole is coated with a mixture of from 30 to 40 parts of ammonium sulphate, and from 35 to 45 parts of gypsum diluted with a sufficient quantity of water.—D. B.

An Improved Process for Preserving Timber. G. Mancion, Rome. Eng. Pat. 5994, May 3, 1886. 4d.

THE wood to be preserved is subjected to the action of low-pressure steam in a closed vessel, in order to swell the wood and create a vacuum for the reception of a solution containing the following ingredients:—156grms. of crystallised arsenic acid, 3600grms. of crystallised carbolic acid, and 100 litres of water. The mixture is rendered alkaline with potash, and introduced into the cylinder, and the wood subjected to its action for about half-an-hour, under a pressure of ten atmospheres. The liquid is then withdrawn, and replaced by the following solution:—10·6kilo. of ferrous sulphate in 1000 litres of water. For one cubic metre of wood, about 50grms. of arsenic acid, 1280grms. of carbolic acid, and 3498grms. of ferrous sulphate are required.—D. B.

X.—METALLURGY, Etc.

An Improved Process and Apparatus for Separating Metals from their Ores, especially Refractory Gold Ores, Mordic, and Sulphurous Ores. Annie Eliza Scott, South Kensington. Eng. Pat. 6674, June 2, 1885. 8d.

THE ore is to be mixed with chloride of lime, and, after standing for some time, to be introduced into a porous vessel placed within an iron or zinc tank, and there covered with brine; brine is also poured into the outer tank. The latter is in metallic connection with carbon plates suspended in the porous cell, and electric action is set up between them; dissolved gold is precipitated by the metal forming the outer vessel. The ore is to be stirred frequently by a freshly amalgamated zinc stirrer. When finished, base metals in the solution may be recovered in the usual way. This is an improvement upon Eng. Pat. 944, 1883.—W. G. M.

Improvements in Apparatus for Lead Burning. P. J. Davies, Kensington. Eng. Pat. 8295, July 8, 1885. 8d.

THIS patent relates to the apparatus employed for generating hydrogen, and to that for supplying the air for its combustion, in the process of autogenous soldering. In principle, the hydrogen generator, which is constructed entirely of lead, resembles Kipp's constant laboratory gas generator, but the details of its construction are modified in various ways. The air supplying arrangement is similar in its action, the pressure of air forced into a lower chamber intermittently by an air pump, being rendered constant by means of a tube from a water tank above, communicating with the bottom of the lower compartment. In each case the volume of gas disposable is indicated by the level of a float in the upper chamber. The air apparatus need not be of lead, since no acid is employed in this case.—W. G. M.

Improvements in the Treatment of Copper Liquors. Nicholas Glendinning, St. Helens, Lancashire. Eng. Pat. 8602, July 16, 1885. 6d.

THE cuprous chloride present in the liquors is converted into the cupric salt by blowing air through the solution in the presence of at least two molecules of free hydrochloric acid to one of the salt; the operation is facilitated by the addition of ferrous chloride (not less than 3FeCl_2 to $2\text{Cu}_2\text{Cl}_2$), otherwise a cuprous precipitate is produced; too much ferrous chloride, however, interferes with the silver precipitation. The liquors may then be desilverised in the usual way with a soluble iodide. If arsenic be present, with much free hydrochloric acid, the excess of the latter should be removed, either by adding alkali or by passing the liquid through a bed of cupric oxide, or of copper precipitate (to increase the quantity of cuprous salt). On passing the air through, the bulk of the arsenic is then precipitated in combination with ferric oxide. The precipitate is allowed to subside, and

the liquid, if necessary, finally cleared by passing through a sand filter, is conveyed to the silver precipitating tank, and afterwards to the copper vats.

—W. G. M.

Improvements in the Manufacture of Steel in Regenerative Open-hearth Furnaces. James Riley, Glasgow. Eng. Pat. 8677, July 18, 1885. 4d.

THE air or the gas (or both) are introduced at increased pressure by connecting the casings of the valves with suitable blowing machinery.—W. G. M.

Soldering Aluminium, and the Preparing of Aluminium for such Soldering. O. M. Thowless, Acocks Green, Warwick. Eng. Pat. 10,237, August 29, 1885. 6d.

A SOLDER, preferably of the following composition, is prepared—tin, 55 parts; zinc, 23 parts; silver, 5 parts; aluminium, 2 parts, by melting the silver with the aluminium, then adding the tin, and lastly the zinc. The bright metallic surfaces to be joined are immersed in dilute caustic alkali or cyanide solution, washed and dried. They are then heated in a spirit lamp, coated with the soldering alloy and clamped together, small pieces of the alloy being placed around the joints. They are now heated to the melting point of the solder, and any excess of the latter is removed by a suitable tool. No flux is used.—W. G. M.

Improvements in the Manufacture of Metallic Alloys. Henry Kesterton, Birmingham. Eng. Pat. 4956, April 9, 1886. 4d.

MANGANESE, first alloyed with some less oxidisable metal, such as aluminium, tungsten, nickel or tin, may be used as a substitute for nickel in German silver or similar white metal alloys.—W. G. M.

An Improved Apparatus for the Washing of Ores and other Minerals. A. R. Gray, Edinburgh. Eng. Pat. 6065, May 4, 1886. 8d.

A RECTANGULAR trough is fitted with a corrugated gun-metal bottom, pierced along the top of each ridge, and the bottom of each furrow, with a number of fine holes, communicating with a water pressure box beneath. At one end the undressed ore is admitted, and at the same end a series of horizontal water jets is so placed that the water may be forced along each furrow of the bottom plate. The overflow for the waste water carrying the lighter particles, and a receiver for the concentrates, are at the other end. The ore, of which the particles should be of uniform size, and which should, therefore, be supplied from classifiers, being admitted at one end of the machine, meets with the fine upward water jets from the bottom plate, which carry the lighter matter into suspension; the heavier granules sink into the furrows, and by the action of the horizontal jets, aided by a slight declivity of the bottom plate, are impelled along these depressions to the lower end of the plate, being throughout their journey subjected to the upward separating motion of the fine jets.—W. G. M.

XI.—FATS, OILS, AND SOAP MANUFACTURE.

Improvements in the Refining or Separation of Glycerine from Fats and Oils. A. G. Brookes. Eng. Pat. 5383, May 1, 1885. 6d.

TO an emulsion of the fat in sufficient water, 0·1 per cent. of carbonate of tin, or carbonate of zinc, are added, and the whole is heated in an autoclave, under a pressure not exceeding 125lb. per square inch. Various metallic oxides, with or without an alkali, or a metallic carbonate with an alkali, may be used. It is claimed that the time and steam pressure are both reduced, and that discolouration of soap stock is entirely avoided.

—W. L. C.

Improvements in the Purification of Glycerine. O. C. Hagemann. Eng. Pat. 7972, July 1, 1885. 8d.

A SERIES of spiral coils, in an air case, whose temperature can be regulated, are interposed between a glycerine still and the ordinary condenser. When about 10 per cent. of the total condensed product is caught in this intermediate apparatus, most of the impurities are caught there also. A drawing is given.—W. L. C.

Improvements in the Manufacture of Oxidised or Solidified Oil, and in the Application of the same to Wires and Strands. F. Walton. Eng. Pat. 8250, July 7, 1885. 8d.

CHAMBERS containing sheets of metal, usually iron, are filled with boiled oil. The oil is soon drained off, leaving a film on the plates, and hot air is then forced by a blowing apparatus through the chambers; the oxidised oil so produced is melted off the plates by being pressed against a moving endless brass band, heated to 400° or 600° F. In covering telegraphic and other wires or strands with such material, the wire, after being coated, is received on a large drum, on which a spiral groove is cut, and the whole is kept warm until the hardening process is completed. A drawing is given.—W. L. C.

Improvements in Purifying and Concentrating Glycerine, applicable also to the Concentration of other Matters. C. O. Hagemann. Eng. Pat. 7973, July 1, 1885. 8d.

THE apparatus employed much resembles that now in use for condensing alcohol, and consists essentially of a series of transverse trays, with perforated shelves arranged in a vertical column; in consequence of suitable progressive cooling (controlled by thermometers) liquids of different degrees of concentration and purity collect, and can be drawn off, whilst steam or water escapes. A drawing is given.—W. L. C.

Improvements in the Treatment of Soap Lyes to obtain Products therefrom. O. C. Hagemann. Eng. Pat. 8051, July 2, 1885. 6d.

THE soap lyes are causticised by lime, and the caustic alkali saponified by an excess of rosin. Perchloride of iron is then added, if necessary, and after the resulting precipitate is removed, hydrochloric acid is added, and air blown through the heated lyes to remove the sulphur compounds. The lyes are then concentrated, and the glycerine is distilled off.—W. L. C.

Improvements in Apparatus for treating Fatty Matters in order to obtain Fatty Acids and Glycerine therefrom. A. Michel. Eng. Pat. 8403, July 11, 1885. 8d.

TWO boilers or autoclaves are employed, in which a mixture of fatty matter and water is maintained for about eight hours, at a pressure of 16 atmospheres. The glycerine, water and fatty acids are separated by simple subsidence, and the latter are then distilled with superheated steam, the condensing coil of the still being provided with a pump for drawing off the vapours. Drawings are given.—W. L. C.

Improvements in Extracting Fat and other Substances from Dissoluble Materials, and in Apparatus therefor. M. Bauer. Eng. Pat. 9352, August 5, 1885. 8d.

THE apparatus consists of a jacketed receiver to contain the substance to be acted on by the solvent, the contents of which are heated by the volatilisation of the solvent, of a chamber whence the solvent is volatilised, and of an automatic syphon and condenser. The jacketed vessel may also contain animal charcoal for bleaching purposes. Drawings are given.—W. C. L.

Improvements in Making Soaps. J. Townsend. Eng. Pat. 3987, March 22, 1886. 4d.

FATTY matters are saponified, without separation of glycerine, by a slight excess of caustic alkali, and when saponification is complete, this excess is exactly neutralised with boracic acid.—W. L. C.

XII.—PAINTS, VARNISHES, AND RESINS.

Indiarubber. T. Christy. New Commercial Plants and Drugs, 9, 17—19.

THE author remarks that in W. Thomson's paper, "Indiarubber and its Decay" (this Journal, 1885, 710), only one quality of rubber appears to be mentioned—viz., that of Para. This is due, he states, to the fact that there are no reliable data showing the difference between South American, African and East Indian rubber gums. The method of treatment described in Mr. Thomson's paper for coagulating the rubber milk in the Para district, equally applies to the milk of the *Hevea Brasiliensis* and the *Mangabeira*. The method now in use is as follows:—Small cups are attached to the trees, and when filled with juice, are emptied into tin pails of a certain size, having close-fitting lids, the cups being again attached to the trees. After going the round of the trees, the contents of this pail are emptied into another a size larger, and so on till the covered pail of largest size is filled and ready to be strapped on to the saddle of a mule for removal. By this plan the natives are saved the trouble of condensing and preparing the milk for market, by smoking. The large can of rubber milk on arriving at the *magasin* is emptied into a bath of water, the temperature best suited to the rubber being a matter of experience. The lumps of rubber that form in the bath are immediately pressed into thin flat sheets, and carefully wiped. By this means the acid is forced out of the cells or pores in the lump, thus preventing the so-called "rotten" appearance. The author is of opinion that the African rubbers yielded by the Landolphias, prepared in this manner, will produce a stronger rubber. The African rubbers now sent here do not yield, when strained and cleaned, more than 30 per cent. to 55 per cent. of pure rubber gum, owing to the natives adulterating with sawdust, bark dust, etc., to overcome the inconvenience of the stickiness of the juice. The amount of resin in milks varies largely.—O. H.

The Utilisation of the By-products or Waste of Lead Ores for the Manufacture of Pigments therefrom. P. C. Bunn, London. Eng. Pat. 8008, July 1, 1885. 4d.

THE claim includes the use, for the manufacture of colours, of the waste from washing ores of lead, known as "waste slimes and blendes." This waste is to be ground with vehicles, such as boiled linseed oil, for body colours, and mixed with other colours if required.—H. A. R.

Improvements in the Manufacture of Resinous Compounds. J. B. Melvin, U.S.A. Eng. Pat. 5270, April 15, 1886. 4d.

THE main feature of this invention is the manufacture of resinous compounds by treating rosin or other resinous substances with oxide of zinc or other metallic oxides.—H. A. R.

XIII.—TANNING, LEATHER, GLUE, AND SIZE.

A New or Improved Size for Sizing Raw Silk. Jean François Giraud, Lyons. Eng. Pat. 8402, July 11, 1885.

THE following is the composition of the size for one litre:—Japanese vegetable gelatine, alumi, spermaceti, and glycerine, of each 20grms. These substances are dissolved together in water, and the sizing effected in the ordinary way.—B. H.

Improved Substitutes for Leather, applicable for Driving Belts, Boot and Shoe Soles, Covering Machine Rollers, and other uses. M. Zingler, Belsize Park, Middlesex. Eng. Pat. 8963, July 24, 1885. 6d.

THE inventor takes canvas or similar woven fabric and boils it under pressure, in a solution of tungstate of soda, for three hours. The fabric is then boiled in a solution of acetate of lead, and afterwards drained, dried and stretched. The fabric is coated with composition, by means of a spreading machine, ten, twelve or more coats being applied. The composition is varied according to the purpose to which the article is to be applied. The ingredients are—indiarubber, sulphide of antimony, peroxide of iron, sulphur, lime, asbestos, chalk, sulphate of zinc, and carbonate of magnesia. For the proportions the Blue Book must be consulted. The coated fabric is vulcanised, under pressure, at a temperature of 250° F., or more.—B. H.

Improvements in Tanning Hides. Percy Haddan, London. From the Dobson Patent Tanning Process Co., of Lincoln, Nebraska, U.S.A. Eng. Pat. 5476, April 20, 1886. 6d.

THE hides or skins, after unhairing and washing in the usual way, are immersed in a bath of common salt solution in strength 9–11° salinometer for 24–36 hours. They are then exposed in a suitable chamber, to the fumes of burning sulphur, 8–10lb. sulphur being sufficient for 160 heavysides. The hides are then tanned or coloured, in a liquor containing gambier, common salt and alum. The hides are skived and split, the grain portion put in gambier liquor, fumigated again, washed, and “stuffed” with grease or oil. The flesh portion is put in hemlock liquor for 12–24 hours, dried, and is then ready for sale or use.—B. H.

An Improved Method of Tawing Hides and Skins. Nils Alexander Alexanderson and Leonard Hvass, of Stockholm, Sweden. Eng. Pat. 5491, April 20, 1886. 4d.

THE patentees claim the tawing of hides or skins, prepared in the ordinary way, with strongly basic solutions of salts of alumina, oxide of chromium, or oxide of iron, and subsequent solution of the soluble salts in water. The basic solution is prepared by adding a dilute alkaline solution to the solution of alumina or sesquioxide salt. (Eng. Pat. 15,607, 1884; this Journal, 1885, 747.) —B. H.

XIV.—AGRICULTURE, MANURES, Etc.

Use of Ferrous Sulphate in Agriculture. A. B. Griffiths. Chem. Soc. Journ. 1886; Trans. 114–120.

THE author's experiments were continued in 1885. A plot of wheat (size not stated) without ferrous sulphate yielded 30 bushels of grain per acre; a similar plot with $\frac{1}{2}$ cwt. green vitriol per acre yielded 32 $\frac{1}{2}$ bushels. Hence no certain conclusion can be drawn. The proportion of ferric oxide in the ash of the grain and leaves was, however, undoubtedly increased by the use of ferrous sulphate. In another instance the crop of wheat grown with ferrous sulphate was *entirely free from mildew*, and the ash of the plant showed an increase over the normal proportions of ferric oxide and phosphoric acid. Applied to grass land, ferrous sulphate caused an increase of greenness in the grass, and destroyed the moss. The ash of the mosses before treatment contained 6.62 per cent. of ferric oxide, and after treatment 11.56 per cent.; so that they appear to have absorbed a poisonous dose of the iron salt. The ash of the grasses contained only 0.45 per cent. Fe_2O_3 before treatment, and 2.46 per cent. after treatment. A solution of ferrous sulphate of 0.1 per cent. strength is fatal to the potato blight (*Peronospora infestans*) and the wheat mildew. Striking results were obtained with potatoes. An unmanured plot yielded 3 tons per acre; a plot dressed with 1 cwt. kainite, 1 cwt. nitrate of soda, and 2 cwt. superphosphate, gave 6 $\frac{1}{2}$ tons; whilst a plot receiving $\frac{1}{2}$ cwt. per acre ferrous sulphate,

in addition to the other manures, yielded 8 $\frac{1}{2}$ tons. The ash of the tubers grown on the three plots contained respectively 5.15, 5.42, and 7.00 per cent. of ferric oxide, and 15.63, 16.24, and 17.94 per cent. of P_2O_5 ; the ash of the haulm gave similar results. It appears from experiments that when a solution of ammonium sulphate is allowed to percolate through a layer of soil containing ferrous sulphate, much more ammonium is retained by the soil than is the case when the same soil *minus* the ferrous sulphate is used. Ferrous sulphate appears to be a good manure for rose bushes. It is best applied to crops as a top-dressing to the young plants, at the rate of $\frac{1}{2}$ cwt. per acre. It can be detected in the soil after the lapse of six weeks.—J. M. H. M.

Improvements in Fertilising Compounds and in the Process of Manufacturing the same. H. J. Allison, London. From W. S. Pierce, New York. Eng. Pat. 5686, April 27, 1886. 6d.

THE object of the patentee is the preparation of “superphosphate,” “acid” or “monobasic” phosphate, or “reverted” or “bibasic” phosphate, from phosphates of aluminium or iron, such as Redonda or Grand Connetable phosphates. A difficulty experienced in the manipulation of these phosphates by processes hitherto devised is owing to the production of a wet sticky mass, which even after drying again deliquesces and becomes wet. The present invention proceeds as follows:—The dried phosphorite is mixed with sodium chloride, ammonium sulphate, and water, and then treated with sulphuric acid (chamber acid). Potassium chloride may be substituted for the sodium salt, and in other cases sodium sulphate may replace the chloride. The oxides, nitrates, sulphates, and carbonates of potassium or sodium may be used. The mixture is dried at 60° C. and pulverised.—C. C. H.

Preparing Basic Cinder for Use as Manure. J. M. H. Munro, Downton, Salisbury. Eng. Pat. 7740, June 25, 1886.

THE finely-ground basic cinder or slag from the Thomas-Gilchrist process of steel making is treated with sulphuric acid of sp. gr. 1.485 or thereabouts, in the proportion of about 2 parts of acid to 1 of cinder. When the proportions are properly adapted, a fine, light, dry and friable product is obtained, containing much gypsum and soluble phosphates of lime and iron, together with crystallised ferrous sulphate. This may be used directly as a manure in about the same quantities as ordinary superphosphate, but it is found that the proportion of ferrous sulphate is in some cases too great to be of any advantage to crops. To prepare a similar manure, containing a more beneficial proportion of ferrous sulphate, the cinder is mixed with once or twice its weight of mineral phosphate of lime before being dissolved; or by the use of lime, basic cinder, or similar precipitating material, a portion of the ferrous compounds in the fine dissolved cinder is rendered insoluble.—J. M. H. M.

XV.—SUGAR, GUMS, STARCHES, Etc.

Levulose. A. Herzfeld and H. Winter. Ber. 19, 390–394.

THE authors claim priority for the discovery of *trioxybutyric acid* among the oxidation products of levulose with bromine, a fact which Böning has recently announced (Ber. 19, 171). This acid rotates the plane of polarised light to the right; but the $[\alpha]_D$ has not yet been determined. On passing a stream of hydrochloric acid gas through the calcium salt of the acid suspended in absolute alcohol, a double compound, $[\text{C}_4\text{H}_4(\text{OH})_3\text{CO}_2\text{C}_2\text{H}_5]_2 + \text{CaCl}_2$, is thrown down as a white precipitate. The authors employed a levulose dried by being mixed with powdered glass and placed over phosphoric anhydride in a vacuum at 60°, and which gave on analysis numbers agreeing with the formula $\text{C}_6\text{H}_{12}\text{O}_6$. They found as the mean of two determinations $[\alpha]_D = -c^2$

71.4° ($p = 20.1$). A 7.78 per cent. solution of levulose in absolute alcohol gave $[\alpha]_D = -4.8^\circ$ only. Levulose was also prepared from invert sugar by means of absolute alcohol. By repeated solution in this liquid and fractional precipitation this was obtained as free as possible from dextrose; but the values for $[\alpha]_D$ obtained varied from $-4.5.13$ to -40.18° . The authors conclude from this either that it is not possible to separate dextrose from levulose by treatment with absolute alcohol, or that invert sugar contains another carbohydrate, with a lower left-handed rotation; the latter is the more probable, since the crystalline mass showed no bi-rotation when freshly dissolved, as it would have done had dextrose been present. Peligot's calcium salt, $C_6H_{12}O_6 \cdot CaO \cdot H_2O$, was prepared both from uncrystallised and crystallised levulose; this salt suspended in absolute alcohol, and hydrochloric acid gas passed through, dissolved, and after a time a white precipitate containing 48.47 per cent. calcium chloride, separated out; it is probably an ether of levulose. Bismuth nitrate affords a means of distinguishing between dextrose and levulose. When this salt is added in the dry state to a dextrose syrup, it is decomposed with formation of basic nitrate, but on addition to a levulose syrup it is dissolved, and a compound may be precipitated out by alcohol, which explodes on warming. —G. H. M.

XVI.—BREWING, WINES, SPIRITS, Etc.

An Improved Process of Purifying Yeast. J. J. W. Peters, Hamburg, Germany. Eng. Pat. 8908, July 23, 1885. 4d.

A PROCESS for purifying yeast from insects, animalcules and other impurities by treatment with either dilute alkali, acid, or water alone, and afterwards with a liquid of less gravity than water—alcohol, for instance—in order to separate the pure yeast from mucilage and secondary ferments. —G. H. M.

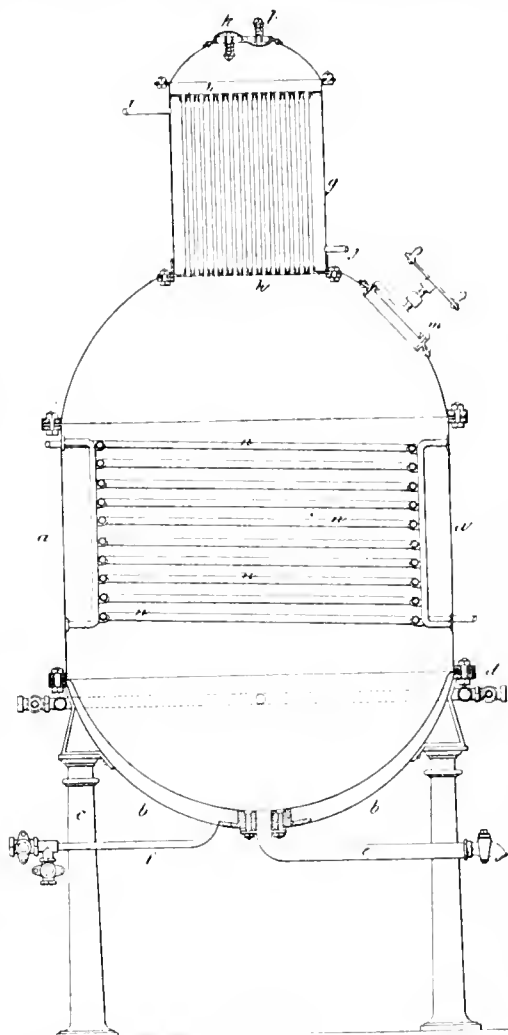
Maturing of Spirits in Bottles or other Non-absorbent Vessels. W. W. Crawford, Glasgow. Eng. Pat. 9869, August 20, 1885. 4d.

THE object of this invention is the maturing of spirits in bottle by the use of wood—either immersed in the fluid or else in the form of a bottle-stopper. —H. A. R.

An Improved Method of and Apparatus for the Treatment of Beer Returns and other like Alcoholic Liquids. F. Faulkner and G. R. Wilson. Eng. Pat. 1461, February 1, 1886. 8d.

THIS consists of an apparatus in which beer returns and waste fermented liquids generally may be sterilised, after being made bright by artificial fining or filtration, by being heated to 180° , and maintained at that temperature for 10 minutes. In the case of beer returns, all acidity over and above the one-tenth normal to mild beers should, after sterilisation, be neutralised by the addition of a standard solution of pure potassium carbonate. The accompanying illustration shows a vertical section of the apparatus employed:—*a* is a copper vessel; *b* a jacket, in which the bottom of the vessel *a* is enclosed; *c* are supplying columns; *d* is a pipe by which the vessel *a* is filled; *e* is a draw-off pipe; *f* is a pipe supplying steam to the jacket; *g* is a surface condenser occupying the upper part of the vessel *a*—it consists of a nest of parallel tubes between two tube plates *hh*. Cold water is admitted to the space around the tubes and between the tube plates by the pipe *i*, and it passes away by the pipe *j*. The vapour rising from the liquor in the vessel *a* is condensed in the tubes of the surface condenser, and falls back. Air is able to escape by a safety-valve *k* opening outwards, and another safety-valve *l* opening

inwards prevents all risk of collapse. *m* is a man-hole cover; *n* is a coil of pipes through which cold water can



be circulated to rapidly cool the liquid at the end of the operation. —G. H. M.

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

(A) CHEMISTRY OF FOODS.

A New Process or Method for Preserving all kinds of Vegetable Products. C. H. Sharman, Forest Hill. Eng. Pat. 9053, July 28, 1885. 4d.

THE patentee claims the following method and compound for coating fruit or vegetables so that they may be preserved in their original condition. The fruit or vegetable is dipped into a melted mixture of wax 8 parts, resin or gelatine one part, and sulphur one part. A hard coating is formed on the exterior of the article, and decay and shrinking are prevented. —C. C. H.

(C) DISINFECTANTS.

The Influence of Thalline Salts upon Putrefaction and Fermentation. H. Schnitz. Centralb. Med. Wissensch. 1886, 113.

FROM the special manner in which thalline preparations influence the organism in cases of fever, it might be sup-

posed that they would act similarly in the matter of putrefaction and fermentation. The experiments on the fermentation of animal tissue demonstrated the correctness of this supposition. 0.5 per cent. of thalline sulphate in sterilised gelatine prevent further putrefaction of meat. The yeast fermentation was considerably retarded by the addition of 1 per cent. of thalline tartrate; with a less quantity, however, the activity of the ferment was increased.—J. B. C.

An Improved Disinfectant. W. R. Lake, London. From M. R. Garcia, Paris. Eng. Pat. 9353, August 5, 1885. 6d.

A LIQUID composed of water 5 parts, permanganate of potassium 2 parts, citric acid 1 part, oxalic acid 1 part, and sulphuric acid 1 part, is poured upon a powder composed as follows:—Calcined marble 5 parts, suboxide of manganese 1 part, sulphate of alumina and potassium 0.5 part, permanganate of potassium 1 part, manganate of potassium 0.5 part, and citric acid 1 part.—C. C. H.

Improvements in Disinfectants. A. Boake and F. G. Adair-Roberts, Stratford. Eng. Pat. 12,238, October 14, 1885. 4d.

THE patentees claim "the use of sulphurous acid as a disinfectant, by releasing the same from a closed vessel wherein it has been stored in the liquid state."

—C. C. H.

Improvements in Disinfecting Compounds. H. H. Lake, London. From F. L. Sarmiento, W. G. Grimm, S. P. Sadtler, J. A. Wiedersheim, Philadelphia, and F. J. Sarmiento, Detroit. Eng. Pat. 5151, April 13, 1886. 6d.

DRY bleaching powder is mixed either with coal-tar, "light oil," or "dead oil," or else with a dry carbolate, such as carbolate of lime. The specification points out the difference in action between the mixtures so made and those described by other patents, each of which they specify—viz., that a reaction occurs which results in the formation of "chlorine, carbolic acid vapours, and other gases of great disinfecting value."—C. C. H.

XIX.—PAPER, PASTEBOARD, Etc.

Process for Preparing Fodder from certain Waste-products obtained in the Manufacture of Cellulose or Paper-pulp. H. J. Haldan, London. From C. H. Voigt, Saxony. Eng. Pat. 7495, June 19, 1885. 6d.

THE inventor claims to be able to obtain from the alkaline boiling lye the 40 per cent. of carbo-hydrates, protein substances, etc., contained in straw, by neutralising with dilute sulphuric acid and separating the precipitated matter by the use of the filter-press. It is stated that the product has an agreeable smell and taste, and is readily eaten by cattle. Glauber's salt may be prepared from the mother-liquor by crystallisation after evaporation.—H. A. R.

Improvements in Process for Making Paper Stock. J. D. Tompkins, U.S.A. Eng. Pat. 3472, March 11, 1886. 8d.

THE following are the claims in this specification:—

1. In the manufacture of paper stock, or pulp, the process of treating wood, straw, grasses, or other vegetable substances by the action of pure water, at about boiling temperature, circulated through the mass of material, within a digesting chamber, in alternating reversed directions.

2. In the manufacture of paper stock or pulp from vegetable substances, or materials, the process of separating the dissolved portions from the undissolved portions of the said material, above described, the same consisting of circulating the cooking water, or other liquors with which the material has been treated, in an

upward direction through the mass, or in a direction which will be away from the discharge opening of the digesting chamber, substantially as described.

3. In the manufacture of paper stock or pulp from vegetable substances, or materials, the process of subjecting the material to the action of alkaline, or equivalent disintegrating and dissolving liquor, at high temperature and under pressure, with said liquor circulated through the mass of material in alternating reversed directions.

4. In the manufacture of paper stock, or pulp, from vegetable substances or materials, the process of cleansing the material from all the dissolved substances, or chemicals, or both, left with it from its prior treatment, the same consisting of circulating pure water in alternating reversed directions through the mass of material within the chamber.

5. In the manufacture of paper stock, pulp, or fibre, the process of bleaching the same, consisting in treating the stock, pulp, or fibre, to the action of a bleaching liquor, circulated through the mass in alternating reversed directions, substantially as described.

6. The process of reducing vegetable substances, or materials, consisting in first boiling the same in pure water, at about boiling temperature, which is circulated in alternating reversed directions through the material until the water soluble portions are dissolved, then treating the material to pure water which is circulated alternately in reversed direction for removal of the dissolved substances, and then subjecting the resulting product of the boiling with water to the action of an alkaline, or other known equivalent dissolving or disintegrating liquor, at high temperature and under pressure, and circulated in alternating reversed directions through the treated mass.

7. In the manufacture of paper pulp or stock, the continuous process for treating wood, straw, grasses, or other vegetable substances, or materials, above described, the same consisting in the several progressive steps of treatment of the material by water, alkaline, or equivalent liquor, and bleaching liquor, which are respectively circulated with alternating reversed directions, through the body of the treated material, in the order and under the respective conditions substantially as above set forth.

—W. S.

Improvements in the Construction of Boilers for Treating Wood and other Fibre in the Manufacture of Paper and other Pulp. C. C. Springer, U.S.A. Eng. Pat. 8073, July 3. 8d.

THE new feature in this invention is the use of elastic bands of asbestos or indiarubber in making joints in the combined metal linings of bisulphite wood boilers. The compound lining (lead and iron) is similar to that patented by John Makin, October 24, 1881, 14,071. By this method of making joints the use of the blow-pipe is obviated, and any expansion of the lead only causes the joint to become tighter. Also sections can be conveniently removed from the boiler and replaced if required.—H. A. R.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Downake (Sarcoccephalus esculentus Afzelius). T. Christy. New Commercial Plants and Drugs, 9, 7—9.

AN addendum to a previous paper by Messrs. Heckel and Schlagdenhauffen (this Journal 1885, 570). The alcoholic extract was found to contain, as well as a small proportion of glucose and trace of tannin, three distinct principles of a resinous nature, the first of which being of an orange-yellow colour, very bitter and soluble in water, alcohol, and potash; the second light yellow in colour, soluble in potash but not in water, the third soluble in potash and insoluble in water and alcohol. Treatment with water gave a mixture of starchy and albuminous substances, and the parts soluble in water were found to be, including 2.123 of salts, 44.55. A

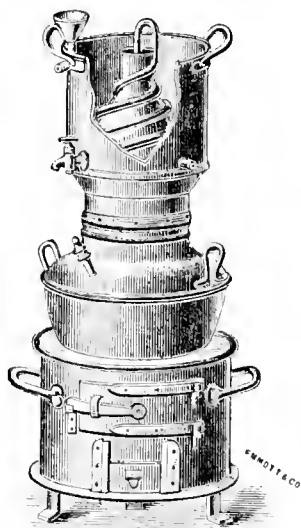
rather large proportion of oxide of iron was found. The results were as follows:—

Parts soluble in petroleum ether, wax, fatty bodies	1.200
" " chloroform, wax, fatty bodies and	
" " colouring matters	1.040
" " alcohol, traces of tannin, glucose,	
" " resinous colouring matters	6.950
Fixed salts	23.112
Wood	62.128
Fixed salts	5.570
	100.00

Messrs. Heckel and Schlagdenhauffen say, that so far as doundakine is concerned it is a substance which is not obtainable as a crystalline alkaloid, but that this name may be given to the colouring matter which contains the active principle. The bitterness of this bark, whether that from Boké or that from Sierra Leone, is due to the nitrogenous and resinoid colouring matters diversely soluble in water and alcohol.—O. H.

Essential Oil Plants. T. Christy. New Commercial Plants and Drugs, 9, 11—14.

UNTIL now but little attention has been given to the cultivation of plants yielding fragrant essential oils, partly for the want of information respecting the extraction of the oils, and partly for want of a suitable apparatus for distilling them, such as could be easily and economically worked on the small scale. Flowers can be treated in various ways. The "fat" process consists of placing the flowers and allowing them to remain for a certain length of time upon layers of clarified fat (beef suet), which absorbs the fragrance, the process being



repeated until the fat is thoroughly impregnated with the perfume. This process, which is by no means exhaustive, is suitable for flowers which, like the violet, do not readily yield their perfume when distilled with water. The perfume is obtained by distilling the impregnated fat. Many flowers can be distilled with water, the perfume coming over and condensing with the steam, from which it can be afterwards separated by an oil separator, or the oil may be allowed to pass off, the water being used in the still again.

Various modes of distilling the essences are required, according to the nature of the product to be operated upon. When the material is dry, and its structure is very close like sandal wood, it should be pounded, scraped, broken up, rasped, or, if possible, pulverised and macerated in water. In the distillation of balsams, the addition of a small quantity of salt is requisite if the boiling point of the oil be higher than that of water.

To preserve the essential oils the author recommends the addition of an equal volume of alcohol to the oil, the

mixture being kept in well-stoppered bottles in the dark.

The extraction of the essences of bergamot, citron, orange, etc., can be best accomplished by pressure, since in these particular instances the oils are more fragrant.

The most simple and reliable apparatus for the distillation is shown in the annexed figure.

It is capable of holding 12 litres, and can be heated by any kind of fuel or it can be worked over any ordinary fire or stove.

The distillation of oils and essences is fully treated in Valyn's "Traité détaillé et pratique de Distillation à l'Usage des Familles."

The Ecuelle process consists in rubbing the fruit over a surface of sharp points lining a saucer-shaped vessel, with a hole in its centre leading to a receptacle placed below; the oil glands being pricked by the points, the essential oil runs down and collects in the vessel below.

—O. H.

Eucalyptus Staigeriana F. V. M. T. Christy. New Commercial Plants and Drugs, 9, 14—15.

THIS tree, which is also known as the lemon-scented iron bark, is a native of Queensland, where it was first discovered by Mr. P. F. Selheim. Its leaves possess an odour exactly like that of the lemon-scented verbenia, and the oil they yield is identical in fragrance with that of the so-called verbenia of commerce, which is not derived from the verbenia, but from a grass (*Andropogon citratus* D. C.). The dried leaves yielded 2½ per cent. of volatile oil of sp. gr. 0.901. The odour of the oil of this tree is quite different from that of *Eucalyptus citrodora*, which might be substituted for *citronelle* oil, which it resembles, in the perfuming of soap.—O. H.

Essential Oil of Lime Leaves (Citrus Limetta). Francis Watts. Chem. Soc. Journ. (Trans.), 1886, 316—317.

THIS oil, prepared by distilling the leaves and young shoots of the lime tree in a current of steam, is moderately soluble in rectified spirit, and has a sp. gr. of 0.8777 at 33°. When submitted to fractional distillation, it yields, first a hydrocarbon (170—220°), then a fraction (229—230°) yielding a crystalline mass with sodium bisulphite, but without action on silver nitrate—hence, probably, a ketone. About one-third of the oil boils above 280°, and is viscid, with a green fluorescence. After digesting the lowest fractions with sodium, a hydrocarbon, boiling at 176—177°, was obtained, inactive to polarised light, and with refractive index of 1.4611 at 30° for red light. It resembles the citrenes, forming a hydrochloride with HCl, and giving Ribau's colour reaction with ferric chloride. Terpinol also is probably present in the lower fraction. The ketone above mentioned yields acetic and pelargonic acids by oxidation with chromic acid; hence it is methylmethylketone $\text{CH}_3\text{CO.C}_9\text{H}_{19}$.—J. M. H. M.

XXI.—EXPLOSIVES, MATCHES, Etc.

The Stability of certain Explosives on Heating. O. Hagen. Rep. Anal. Chem. 6, 1.

THE following test is used:—A copper vessel, 20cm. high and 20cm. diameter, is provided with a copper cover, in which 15 to 20 round holes are bored about 20mm. wide. Through one of these a thermometer is inserted, which dips into the water contained in the vessel to a depth of 10cm., the water-level being about 2cm. below the lid. The remaining holes are provided with three thin strips of copper, through which the samples, contained in test-tubes 16mm. wide and 14—15cm. high, are sunk. Chemically pure nitroglycerine does not change in ½—1 hour at 70—75°, although this is not so in the presence of acid. Sulphuric acid splits off one equivalent of nitric acid with the formation of glycerine-sulphuric acid. The latter, on decomposing into glycerine and sulphuric acid, sets free a further quantity of nitric acid from the nitroglycerine, and this is reduced to lower oxides of nitrogen, especially nitrous oxide. Upon this fact the test is based,

potassium iodide and starch-paper being used. The author uses Swedish filter-paper soaked in a solution of 3grms. starch in 276cc. water and 1grm. KI in 276cc. water. For dynamite, Majendie uses 2.7grms. starch (which has been washed with cold water) in 250cc. water, and 0.9grm. KI (crystallised from alcohol) in 250cc. water. Strips of washed filter-paper are soaked in the mixed solutions for not less than ten seconds. These, cut into strips of 10mm. wide and 30mm. long, are kept in dark stoppered bottles, and before use the upper third portion is painted over with a 40 per cent. glycerine solution, 24° B. By means of a cork and platinum wire, to which the strip is fastened, the strip is suspended in a test-tube. The temperature of the water and the duration of heating when the strip becomes tinted is observed. Dynamite nitroglycerine should indicate no change after fifteen minutes at 71°; gun-cotton for the Prussian sappers must stand a temperature of 180° for twenty-five minutes. In the case of compressed gun-cotton, 1grm. is taken and gently pressed with a wooden pestle into the tube; of explosive gelatine and nitroglycerine 3grms. are taken. The water-bath is kept at a constant tem-

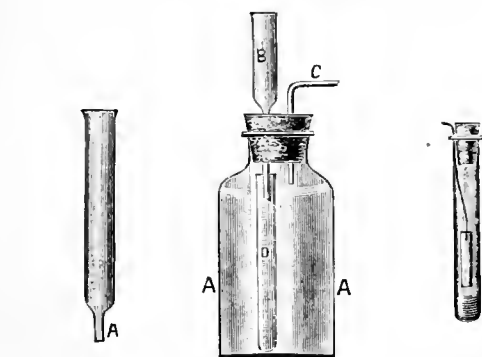
perature, an infusion of the matter is prepared, to which some tartaric acid is added. A bank of wool is then dyed in the solution, which is kept on the boil during that time. The wool thus dyed is washed in very dilute sulphuric acid, and the acid afterwards neutralised with ammonia. If the saffron contained any dinitronaphthol at all, the wool or the solution will be coloured yellow, whereas wool dyed with a decoction of genuine saffron and treated in the same manner becomes colourless.

—S. H.

Remarks on the Applicability of Orange 3 and Methylorange as Alkalimetric Indicators. R. Engel. *Bull. Soc. Chim.* 1886, 45, 424.

THE author examined Witt's tropæoline OO (sodium salt of diphenylamidoazobenzene-sulphonic acid), sometimes also called orange 3, and methylorange (sodium salt of dimethylamidoazobenzene-sulphonic acid), as to their applicability as indicators. The latter was found more suitable, the change of colour being far more distinct. To quickly distinguish between tropæoline OO and methylorange, their reaction with gold chloride is made use of, the former turning violet and afterwards green on addition of gold chloride, whereas methylorange becomes red under the same circumstances. The presence of iron salts interferes with the colour reaction of methylorange, the change of colour being less distinct. If a potash solution be treated with a ferri-compound, the light yellow colour of methylorange turns orange at first and afterwards pink. Sulphuric acid can be very accurately determined with methylorange, even in the presence of sulphuretted hydrogen. This reaction is applied in estimating sulphuric acid in copper sulphate. After precipitating the copper with sulphuretted hydrogen, the liquid is filtered and the sulphuric acid titrated in the filtrate. This method is of general application with metals precipitated by sulphuretted hydrogen.

—S. H.



perature, and the test-tube is sunk in to a level with the bulb of the thermometer. A faint brown line between the dry and the moist portion of the test-paper indicates the end of the reaction. In the case of dynamite, the oil must be separated from the siliceous matter and tested separately. The English Government demands that 24grms. finely-powdered dynamite should be firmly pressed on a loose plug of cotton-wool into the funnel-tube B. On pouring on to this a few cc. of water, the nitroglycerine is expelled, and filters through. This may be accelerated by a vacuum pump in connection with C. The test-tube D must be removed before the layer of water comes through the funnel. The author finds that dynamite often indicates no nitrous oxide when the oil expressed from it gives the reaction distinctly. Temperature of explosion was tested by the author in a paraffin-bath, each result being the mean of ten determinations. Trinitroglycerine, 183.7°; explosive gelatine, 183.9°; ordinary dynamite (75%), 182.3°; English dynamite (73.8% nitroglycerine, 25.4% calcined sand, 0.8% soda), 184.7°; compressed gun-cotton, 162.9°; collodion, 158.4°—J. B. C.

XXII.—GENERAL ANALYTICAL CHEMISTRY.

New Colour Reactions of some Alkaloids. W. Lenz. *Zeits. Anal. Chem.* 25, 29.

THE quinine alkaloids and cocaine give characteristic colour reactions on fusion with caustic potash. Quinine and quinidine give an intense grass-green colouration, cinchonine and cinchonidine a blue-green, and cocaine a greenish-yellow, which on further heating becomes bluish and then dirty rose-red. Quinine also gives by this treatment a characteristic pleasant aromatic odour. The reactions are given distinctly with 0.5mg. of alkaloid.—G. H. M.

Detection of Manchester Yellow (Dinitronaphthol) in Saffron. Cazeneuve and G. Linossier. *Journ. Pharm. Chim. Sér. 6*, 13, 413.

DINITRONAPHTHOL-YELLOW has lately been used to artificially colour natural saffron. To detect the adultera-

New Books.

JAHRESBERICHT ÜBER DIE LEISTUNGEN DER CHEMISCHEN TECHNOLOGIE MIT BESONDERER BERÜCKSICHTIGUNG DER GEWERBESTATISTIK FÜR DAS JAHR 1885. Von Dr. FERDINAND FISCHER. Leipzig: Verlag von Otto Wigand. 1886. London: H. Grevel, 33, King Street, Covent Garden.

OCTAVO VOLUME, in the paper cover usual with German publications, containing Table of Contents and full Alphabetical Indexes to authors and subject matter. The volume is a large one, containing 1375 pages of matter, and it is illustrated by 478 woodcuts. The work is subdivided by the following groupings of the entire subject:—I. GRUPPE: Chemische Metallurgie. II. GRUPPE: Chemische Fabrikindustrie; Unorganisch. III. GRUPPE: Chemische Fabrikindustrie; Organisch. IV. GRUPPE: Glas, Thon, Cement, Mörtel und Künstliche Steine. V. GRUPPE: Nahrungs- und Genussmittel. VI. GRUPPE: Chemische Technologie der Faserstoffe. VII. GRUPPE: Sonstige Organisch-chemische Gewerbe. VIII. GRUPPE: Brennstoffe und Elektrizität.

REPORT by Prof. WRIGHTSON and Dr. MUNRO, of the College of Agriculture, Downton, Salisbury, on Experiments made by them to test the Manurial Value of the Basic Cinder, made at the Works of the North-Eastern Steel Company, Limited, Middlesborough. Middlesborough: *Daily Exchange Office.* 1886.

Monthly Patent List.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

- 8276 W. Briggs, Bradford. Improvements in the method of and apparatus for preventing the issue of smoke from furnaces. Complete specification. June 23
- 8375 W. C. Nickels, London. Improvements in filtering funnels. June 25
- 8422 J. Lyle, Glasgow. Improvements in air or gas compressors. June 26
- 8481 H. H. Salomons, London. Improvements relating to retort covers, lids, or doors. June 28
- 8523 A. Myall, London—Communicated by J. McIntyre, United States. Improvements in surface condensers. June 29
- 8548 H. H. Lake, London—Communicated by J. E. Benninghoff and C. F. Jewell, United States. Improvements in furnaces for the combustion of gaseous fuel. Complete specification. June 29
- 8626 W. Horsfield, London. Improvements in centrifugal drying machines. July 1
- 8630 F. B. Daring, London. Improvements in the means or apparatus for preventing incrustation on the heating surfaces of evaporating vessels, and depositing the particles which cause incrustation in receptacles formed for the purpose. July 1
- 8646 G. Seagrave, London. Improvements in apparatus for inducing the flow of large volumes of air, gas, or other fluid by means of a smaller volume at high velocity. Complete specification. July 1
- 8679 W. A. F. Wiegner, London. Improvements in drying apparatus. July 2
- 8905 S. Vickers, Liverpool. Improvements in apparatus for separating impurities or objectionable matter from solids and liquids. July 8
- 8935 A. M. Clark, London—Communicated by M. Honigmann, Germany. Apparatus for utilising the heat of the exhaust steam from steam engines. July 8
- 9038 A. Myall, London—Communicated by J. McIntyre, United States. Improvements in surface condensers. July 10
- 9098 E. Fischer and M. W. Weber, London. Improvements in amalgamators. July 12
- 9181 J. G. Galley, London. Improvements in apparatus for preventing the deposit and formation of incrustation upon the surface of boiler flues, and for removing such incrustation if formed. July 14
- 9198 A. Harrison, Barrow-in-Furness. Apparatus for charging and drawing heating, smelting, and other furnaces. July 15
- 9199 A. Haacke, London. Non-conducting covering for marine, locomotive, and stationary boilers, to prevent the escape of heat. July 15
- 9220 E. Edwards, London—Communicated by J. Quiri, Germany. A new or improved volatile liquid especially applicable for use in ice-making or refrigerating machines. July 15
- 9259 J. Brown, London. Improvements in apparatus for rapidly heating or cooling liquids. July 16
- 9274 C. J. Galloway and J. H. Beckwith, London. Apparatus for heating feed water for boilers, and effecting deposit of impurities therefrom. July 16
- 9306 F. Skevington, Birmingham. Improvements in illuminating steam, vacuum, compound, and other like gauges. July 17
- 9307 B. P. Walker, Birmingham. Improvements in the construction of apparatus for the distillation of solid materials. July 17
- 9312 B. D. Healey, Liverpool. Improvements in refuse furnaces and apparatus therefor, partly applicable to other furnaces. Complete specification. July 19
- 9355 W. H. Akester, London. Improved means for obtaining solutions of soluble materials. July 19
- 9394 W. S. Mackie, London. Iadiarubber covering for blow-off pits. July 20
- 9465 J. Bonthron and R. B. Bonthron, Glasgow. Improvements in and connected with furnaces. July 21
- 9488 F. W. Brownlow, Manchester. Improvements in filters. July 22
- 9497 R. Johnson, Manchester. Improvements in supplying atmospheric air to combustion chambers or flues of steam boiler and other furnaces. Complete specification. July 22

COMPLETE SPECIFICATIONS ACCEPTED.*

1885.

- 9225 W. F. R. Weldon—Communicated by A. R. Pechiney et Cie. Apparatus for heating solid substances out of contact with the products of the combustion of the fuel employed. July 13

- 9876 J. Murrie. Method of generating vapour. July 9
- 9963 S. Robertson. Filters, and apparatus connected therewith. July 16
- 10028 D. Fulton—Communicated by E. Laroche. Means for interrupting the flow of fluids in pipes or conduits. July 16
- 10112 A. Reis. Apparatus for producing draught in furnaces, and for purifying the products of combustion. June 29
- 10143 J. A. Drake and R. Muirhead. Improvements in and connected with filter presses. July 2
- 10355 E. Edwards—Communicated by G. Lunge and L. Rohrmann. Apparatus for effecting the absorption of gases by liquids or solids. July 8
- 10577 W. L. Wise—Communicated by L. Pommeraye. Improvements in filters. July 6
- 10581 J. S. Edwards and J. Edwards. Apparatus for drying animal matter, etc., and for evaporating liquids. July 2
- 10593 R. Hainesworth. Means of condensing the steam arising from set-pans. June 25
- 10642 E. Edwards—Communicated by E. Rothe. Centrifugal machines. July 16
- 10607 J. Murrie. Apparatus for separating vapours from liquids. July 6
- 10942 J. B. Allfott. Filter-presses and apparatus connected therewith. July 20
- 11143 J. Patterson and M. Sandison. Application of forced draught to furnaces. July 6

1886.

- 6673 E. Fales. Smoke consuming furnaces. July 6
- 6812 T. T. Mathieson and J. Hawliczek. Improvements in and in connection with distilling apparatus. July 13
- 7406 G. Criner. Furnaces for the combustion of fuel. July 9
- 8276 W. Briggs. Method and apparatus for preventing the issue of smoke from furnaces. July 23

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

- 8259 H. G. Walker, London. Improvements in the manufacture of night-lights, and in apparatus therefor. June 22
- 8291 H. D. Cunningham, London. Improvements in the production and application of hot air. June 23
- 8305 R. Henderson and S. Levy, London—Communicated by G. H. Kohn, United States. Improvements in or relating to furnaces for the manufacture of water-gas. June 23
- 8312 P. Fariaux, London. An improved apparatus for the manufacture or production of carbonic acid and other gases. June 23
- 8348 J. Hammond, London. Improvements in the method of, and in apparatus for the complete purification of coal-gas, by concentrated liquid ammonia, and the recovery of sulphur and ammonia for the manufacture of sulphuric acid and sulphate of ammonia. June 24
- 8349 A. M. Clark, London—Communicated by G. E. Wéry, France. Improved means of consuming smoke and economising fuel in furnaces and fire-places. June 24
- 8357 S. Butler, London. Improvements in machinery for the manufacture of compressed fuel from coal. Complete specification. June 24
- 8411 J. Dredge, London. Improvements in apparatus for producing intense heat by gas. June 26
- 8474 J. Heydon, Mansfield, Notts. Improvements in the means and apparatus for burning gas-tar, which is applicable for heating steam boilers. June 28
- 8484 G. Symes, London. Improvements relating to the purification of gas, and the impregnation of the same with hydrocarbon or other vapour, and to apparatus therefor. June 28
- 8494 R. Tervet, Glasgow. Improvements in apparatus for distilling or refining mineral oils. June 29
- 8548 H. H. Lake, London—Communicated by G. E. Benninghoff and C. F. Jewell, United States. Improvements in furnaces for the combustion of gaseous fuel. Complete specification. June 29
- 8549 H. H. Lake, London—Communicated by G. E. Benninghoff, United States. Improvements relating to the utilisation of gas or vapours for lighting and heating purposes, and to apparatus therefor. Complete specification. June 29
- 8583 A. J. Boulton, London—Communicated by S. Bond, Turkey. Improvements in apparatus for consuming smoke and saving fuel. June 30
- 8756 R. Tervet and F. Alison, Glasgow. Improvements in treating and purifying paraffin wax, and in apparatus therefor. July 5
- 8761 W. C. Haigh and A. A. Haigh, Manchester. Improvements in artificial fuel. July 5
- 8825 H. Cockey and F. C. Cockey, Westminster. Improvements in gas washers. July 6
- 8878 W. Moffatt, Glasgow. Improvements in apparatus for heating and cooking by gas. July 7
- 8880 H. J. Hadden, London—Communicated by H. Welsh, United States. Improvements in apparatus for promoting the combustion of fuel. Complete specification. July 7
- 8895 H. Williams, Manchester. Improvements in and apparatus for obtaining gas for illuminating, heating and other purposes. July 7
- 8902 A. J. Boulton, London—Communicated by A. Blancfort. An improved method of or apparatus for effecting the decomposition of hydrocarburet and water vapour mixed in closed vessels. July 7

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Specifications thus advertised are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

8918 R. Tervet and F. Alison, Glasgow. Improvements in treating and purifying paraffin wax, and in apparatus therefor. July 9

9025 C. Oswald, Liverpool. Improvements in and connected with burning inflammable oils or liquids for heating or lighting purposes. July 10

9017 J. Blum, London. The instantaneous generation of steam. July 12

9082 A. R. Upwards and C. Pridham, London. Improvements in gas batteries, and in the application of the same to electric lighting and other uses. July 12

9116 J. Roberts, London. Process of and apparatus for manufacturing heating and illuminating gas. Complete specification. July 13

9260 H. Clay Bull, Liverpool. Improvements in the manufacture of gas, and in apparatus therefor. July 16

9262 J. Hammond, London. Improvements in the method of and in apparatus for supplying liquid fuel to furnace and other fires. July 16

9275 J. C. Grant, London. A method and apparatus for distilling solid materials for the production of gases and vapours therefrom. July 16

9291 R. Ashton, Manchester. Making self-extinguishing candles. July 17

9312 F. Sahlfeld, London. A process and apparatus for distilling and rectifying raw fatty acids and residues, or waste containing fatty acids. July 17

9158 R. Stone, London. Improvements in the application of various inflammable fluids and substances to all kinds of materials requiring high temperatures in their manufacture. July 21

9167 H. Süss, Liverpool. Improvements in or appertaining to magnesium lamps. Complete specification. July 21

9173 J. Livesey and W. Whitehouse, London. An improvement in apparatus for enriching gas by admixture of hydrocarbon vapour. July 21

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

9679 H. J. Rogers. Gas retorts, and apparatus connected therewith. June 25

9071 J. J. Royle. Improvements in and apparatus for heating water and generating steam by gas or other fuel, and automatically controlling the same. June 25

1886.

3300 J. H. Campbell. Using binary liquids, especially aqua ammonia, as a motive power. July 6

4163 A. Thomas. Means for regulating the flow of gas tar to be used as fuel in gas and other works. July 6

6317 O. Inray—Communicated by J. B. Archer. Apparatus for conversion into gas and combustion of liquid hydrocarbons. July 2

6811 J. Maclear. Appliances for increasing the illuminating effect of gas. June 29

8091 B. J. B. Mills—Communicated by C. T. Burchardt. Applying auxiliary heat to steam boilers. July 20

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

8528 C. P. Anderson, London. Improvements in detergents and dyes. June 29

8992 C. D. Abel, London—Communicated by The Farbwerke vormals Meister, Lucius, and Brünning, Germany. Improvements in the production of green colouring matters or dyestuffs. July 9

9176 L. J. B. A. J. Bouillet, London. Improvements in the manufacture of ultramarine, and in furnaces or ovens, and apparatus to be used in this manufacture. Complete specification. July 11

9489 J. Crawford and J. Crawford, Glasgow. Improvements in apparatus for treating and supplying or distributing coloured or other powders. July 22

V.—TEXTILES, COTTON, WOOL, SILK, ETC.

APPLICATION.

8196 J. Dawson, Manchester. An improved composition or mixture to be used for glossing linen. June 29

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

2817 G. W. H. Brogden and E. Casper—Communicated by E. Fremy and V. Urbain. Treating fibres from the barks of plants of the urtica family, etc. June 29

6908 W. B. Ritchie. Manufacture of bituminous and other felts. June 25

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

8249 T. Hauschell, Glasgow. Improvements in apparatus for washing, dyeing, drying, or similarly treating wool, cotton, and other textile or fibrous materials. June 22

8125 J. T. Sawney and C. E. Quick, Hull. Improvements in sizing loose coloured wall-paper and distempered decoration, and showing each colour perfectly distinctly. June 26

8903 L. M. Lardière, London. Improvements relating to the printing or colouring of yarns for the manufacture of woven fabrics. July 7

9286 F. A. Gatty, Manchester. Improvements in dyeing wool or other animal fibres in either the raw or manufactured state. July 17

COMPLETE SPECIFICATION ACCEPTED.

1885.

12534 J. H. Ashwell. Apparatus applicable for dyeing, scouring, and other like purposes. July 13

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

8217 J. H. Dennis and N. Glendinning, Liverpool. Improvements in obtaining sulphide of zinc from solutions. June 22

8308 L. Mond, Liverpool. Improvements in obtaining chlorine. June 23

8312 P. Farinaux, London. An improved apparatus for the manufacture or production of carbonic acid and other gases. June 23

8599 J. Magnall and W. Bratby, Blackley. Apparatus for generating carbonic acid gas. July 1

8602 J. Park, Glasgow. Improvements in the manufacture of bichromate of ammonia. July 1

8723 E. Solvay, London. A new or improved process for the simultaneous manufacture of assimilable phosphates, and of sulphate of ammonia. July 2

8819 L. A. Chevalet, London. Improvements in apparatus for distilling and purifying ammoniacal liquids. July 6

8832 A. Schanschietz. See Class XVIII.

8860 A. M. Clark, London—Communicated by M. Honigmann, Germany. Improvements in the manufacture of caustic soda. July 7

8906 G. A. Jarvis, Wellington, Salop. Improvements in the manufacture of carbonates of soda and potash. July 8

8971 S. Bowen Bowen, London. Improvements in apparatus for the concentration of sulphuric acid. July 9

9032 J. Marx, London. Improvements in the manufacture of alkalis. July 10

9208 H. W. Deacon and F. Hurter, London. Improvements in apparatus for producing ammonia from sulphate of ammonia. July 15

9218 W. Cooper, Salford. An acid-box for regulation of vitriol and prevention of blow-backs. July 16

9276 E. Böhlig and G. O. Heyne, London. An improved process for separating waste lye containing chlorate of magnesium into magnesia and hydrochloric acid, for manufacturing carbon magnesia as material for cleansing feed-water for boilers for clarifying and decoloring all kinds of fluids, and especially for cleansing all kinds of factory spent lye and sewage waters, and rendering the same innocuous. Complete specification. July 16

9566 O. Inray, London—Communicated by La Société Anonyme pour l'Étude et la Création des Soudières, France. Improvements in apparatus employed in the ammonia-soda process. July 19

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

8721 W. P. Thompson—Communicated by Solvay et Cie. Manufacture of chlorine from by-products of the ammonia-soda process, or similar chemicals from other sources. June 25

9227 W. F. R. Weldon—Communicated by Pechiney et Cie. The decomposition of the magnesia of the residual ammonium chloride of the ammonia-soda process. July 6

9831 W. F. R. Weldon—Communicated by Pechiney et Cie. Decomposing by magnesia the mother-liquor of the ammonia-soda process. July 6

9833 T. H. Cobley. Manufacture of carbon-alum and application of the same to useful purposes. June 25

10700 J. J. Hood. Manufacture of ammoniac bichromate. July 9

11192 J. Brock and E. Saye. Means or apparatus for distributing or conveying acids or other liquors to the cisterns or tanks of chemical towers, vats, etc. July 16

1886.

6999 W. C. Wren. Process and apparatus for distilling ammonia. July 9

7355 H. H. Lake—Communicated by U. Cummings. Manufacture of sulphuric acid. July 13

7125 C. Petri. See Class XVIII.

7663 C. Toppan. Bleaching compounds. July 9

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

- 8477 W. Kent and C. Cope, London. Improvements in machinery or apparatus for working or mixing plastic materials, such as potters' clay. June 28
- 8526 J. H. Windmill, London. Improvements in and apparatus for the manufacture of glass bottles and glass jars, and other like glass articles. June 29
- 8677 J. C. Arnall and H. M. Ashley, Ferrybridge, Yorks. Improvements in the manufacture of bottles and other articles in blown glass. July 2
- 8713 M. H. Blanchard, London. Improvements in the manufacture of ornamental and other tiles. July 2
- 8797 T. Thorp, Whitefield, Lancashire. A new or improved glass enamelling process. July 6
- 9015 W. H. Jones, B. Jones, W. Hall Jones, and B. H. Jones, Wolverhampton. An improved apparatus connected with the fusing of enamel-ware. July 10
- 9137 A. Moore and W. E. Moore, London. The production of ornamental transparent and semi-transparent glass letters and ornamental glass. July 13
- 9217 O. C. Hawkes, London. New or improved machinery for bevelling and moulding the edges of plates of glass and for ornamenting the surfaces of plates of glass. July 15
- 9226 H. H. Lake, London—Communicated by M. P. H. Beconlet and L. J. O. Bellet, France. Improvements relating to the manufacture of sheets or plates of glass and other glass articles. July 15

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 6579 J. D. Denny. Improvements in tiles, and appliances for making the same. June 29
- 11084 H. Venables. Glazing china, porcelain, earthenware, and Parian. July 9
- 11208 A. Laudier and C. Hondaille. Decorating objects of glass, crystal, or ceramic ware. July 6

1886.

- 8023 F. S. Shirley. Manufacture of glass and articles therefrom. July 16

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

- 8339 R. Steinau, London. Improvements in facing bricks, and in the manner of setting the same. June 24
- 8118 W. G. Wodson and R. Skeoch, Birmingham. Improvements in the process of manufacturing bricks, ridge-tiles, and other such like clay articles. June 26
- 8836 E. H. Bassett, London. An improvement in asphalt pavement. July 6
- 8934 F. C. A. Meier, London. Improvements in centrifugal apparatus for moulding or casting clay, cement, plaster, and other similar materials. Complete specification. July 8
- 8957 R. Skeoch and W. G. Wodson, East Heaton. An improved escape kiln for the burning of all classes of bricks and other clay goods. July 9
- 9108 H. H. Leigh, London—Communicated by B. Dubois, France. An improved method of constructing ornamental masonry columns. Complete specification. July 20
- 9136 J. A. Parker, London. An improved composition for paving or covering roads and ways, floors, and other surfaces. July 20

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 10541 M. B. Parrington. Kilns, etc., employed in the manufacture of lime and cement. July 13
- 11001 W. Hassall. Composition or cement specially applicable for use in jointing stoneware, concrete, or like pipes. July 9
- 11008 R. Stone. Manufacture of cement. July 23
- 11270 E. W. Killick. Manufacture of cement. July 23
- 11271 E. W. Killick. Kilns. July 20
- 11239 A. Cochran. Apparatus for making clay bats. July 20
- 11589 R. B. Lee and J. Hodgson. Construction of fireproof pillars and columns. July 2
- 11725 R. B. Lee and J. Hodgson. Manufacture of concrete fireproof building materials and parts of buildings, etc. July 9

1886.

- 7361 H. H. Lake—Communicated by U. Cummiogs. Manufacture of cement. July 9
- 7675 H. Mathey. Manufacture of cement. July 23
- 7676 H. Mathey. Method of colouring cement. July 23

X.—METALLURGY, Etc.

APPLICATIONS.

- 8320 J. Webster, London. An improved metallic alloy. Complete specification. June 23

8324 A. Gutensohn and J. M. James, London. Improvements in the process of pickling or cleaning the surface of iron or other metal previous to coating such surface with tin or other metal. June 23

8338 T. Twynam, London. Improvements in and connected with refractory linings, particularly adapted for metallurgical furnaces, but applicable also for other purposes. Complete specification. June 21

8339 T. Twynam, London. Improvements in and connected with refractory linings, particularly adapted for metallurgical furnaces, but applicable also for other purposes. June 21

8387 G. Francis, Liverpool. Improvements in and relating to tamping blast holes in mines and other places. June 25

8390 R. Heathfield, London. Improvements in apparatus used for coating sheet iron with zinc or alloys of zinc or other coating metal or alloy. June 25

8397 W. Baker, J. Baker, and W. H. Baker, London. Improvements in coating or covering surfaces of sheet iron or steel, and of tin andterne plates, and of articles made of such iron and steel and plates. June 25

8408 G. Baron de Overbeck, London—Communicated by H. de Groussilliers, Germany. Improvements in the production of aluminium chloride. June 25

8424 A. R. Ormiston and J. Ormiston, Glasgow. Improvements in processes and apparatus for testing miners' safety lamps. June 26

8491 G. Baron de Overbeck, London—Communicated by H. de Groussilliers, Germany. The treatment of aluminous minerals, especially bauxite, to separate iron therefrom. June 28

8531 F. J. R. Seaver, London—Communicated by E. C. Keiner-Fiertz, Switzerland. Improvements in and connected with the manufacture of aluminium and other light metals. June 29

8564 G. Baron de Overbeck, London. Communicated by H. de Groussilliers, Germany. Improvements in the electrolytic production of aluminium. June 30

8608 M. Settle, Manchester. Improvements in electric safety lamps for use in mines. July 1

8833 C. B. Heady, London. Improvements in gold-covered alloy. Complete specification. July 6

8844 E. Morand, London. Improvements in instruments or apparatus for detecting and signalling the presence of carbonated hydrogen in mines and other places. July 6

8881 P. M. Justice, London—Communicated by H. T. Rode, Germany. Improvements in the manufacture of steel and ingot iron. July 7

8888 H. Bonser and T. G. Marsh, London. Improvements in apparatus used in blasting for mining and other like purposes. July 7

8962 E. Martin, London. Improvements caused in the extraction of precious metals. July 9

8966 D. Owen, London. Improvements in the manufacture of tin and such like metal-coated plates and in the apparatus employed therein. July 9

8988 T. Fenwick, London. Improvements in the treatment of waste tin cuttings to recover tin and also iron in a state fit for re-manufacture, also in apparatus to be employed in this treatment. Complete specification. July 9

8989 E. Cottam, London. Improvements in the manufacture of German silver. July 9

9138 P. Higgs, London. An improved process and apparatus for obtaining spelter and other products by the treatment of zinc ores. July 14

9327 R. Kirkman and H. J. Kirkman, London. Improvements in the manufacture of tinned plates and of other tinned articles. July 17

9132 H. Leipmann. See Class XVIII.

9486 L. Grabau, London. Improvements relating to the production of aluminium and alloys thereof. July 22

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

8112 J. Sedgwick. Miners' safety lamps, with nickel or other reflector. July 2

8574 H. R. Cassel. See Class XVIII.

9003 H. Grimshaw. Process for treating galvanised iron or steel. July 2

10018 H. H. Lake—Communicated by The Verein Chemischer Fabriken. Separation of tin from tin-plate, and production of protochloride of tin. July 9

10119 S. H. Stephens and S. Rodda. Machinery for the reduction of tin stuff and other partially pulverised ores, to extract the metal therefrom, and for grinding other hard substances. July 20

11067 W. Beaton. Recovering tin from waste tinned iron. July 9

11113 G. Hertzog. Moulding apparatus for foundry purposes. July 13

11280 D. Davis. Apparatus employed in coating metal plates with tin, terne, or other metals or alloys. July 13

11005 W. Galloway. Tamping shot-holes for blasting in mines. July 2

1886.

8326 J. Webster. An improved metallic alloy. July 23

XI.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

- 8615 P. Gill, Liverpool. Improvements in or appertaining to soap frames. July 1

8636 P. J. Davies, London. Improvements in oil bleaching or refining apparatus. July 1
 8717 A. Macqueen, Tunbridge Wells. Soap manufacture by the introduction of Fuller's earth to make it the best quality for domestic, nursery, and toilet purposes. July 2
 8921 J. Whittle, London. Improvements in apparatus for extracting or separating oil or grease from cotton waste and similar materials. Complete specification. July 8
 8933 J. L. Mott, jun., London—Communicated by Dreher & Co., United States. Improvements in lubricating compounds. Complete specification. July 8
 9257 J. Baird, Glasgow. A new or improved machine, or arrangement of mechanism, for slicing or cutting soap. July 16
 9115 H. H. Lake, London—Communicated by W. B. Albright, United States. Improvements relating to the bleaching of fats and oils. Complete specification. July 20

COMPLETE SPECIFICATION ACCEPTED.

1885.

12192 A. T. Hall. Extracting oils from certain waste products. June 25

XII.—PAINTS, VARNISHES, AND RESINS.

APPLICATIONS.

8112 F. Greening, London. A new or improved manufacture and process of production of material that can be used as or in the making of substitutes for indiarubber, varnish, ivory, whalebone, and other substances. June 26
 8725 J. M. Benoett, Glasgow. Improvements in the manufacture of pigments. July 3
 8747 J. Aniello, J. Kennedy, and J. B. Barket, London. An improved anti-fouling and preservative paint or varnish. July 3
 8837 F. Maxwell Lyte, London. Improvements in the production of white lead. July 6
 9001 E. O. Eaton, London. Improved blacking and varnish. July 10
 9027 E. School, London. Process for the production of resin-acid esters applicable as substitutes for the resins or gums usually employed in the manufacture of varnishes and lacquers. Complete specification. July 10
 9101 E. Tuteur, London. A new or improved method of and material for coating, lacquering, or enamelling metals for resisting atmospheric influences, water, acids, alkalis, and the like. July 20

XIII.—TANNING, LEATHER, GLUE AND SIZE.

APPLICATIONS.

8363 J. Hurry, London. Crocodile leather floor covering made from real crocodile skins. June 25
 8143 T. N. Ashman, London. An improved composition for treating leather and leather articles. June 26
 8582 A. J. Boulton, London—Communicated by Count V. de Nydpruck, Belgium. Improvements in tanning. June 30
 9017 F. J. Pohl, Bootle. Improvements in tanning hides and skins. July 10

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

8626 G. F. Redfern—Communicated by A Buckingham. A material to be used as a substitute for leather, etc. July 6
 11864 A. Hitchon. Boiling size under steam pressure. July 6

1886.

6011 F. R. Maggs. A substitute for urine or "sig" for use in preparing leather and skins for dyeing. July 6

XIV.—AGRICULTURE, MANURES, ETC.

APPLICATIONS.

8723 E. Solvay. See Class VII.
 8938 P. de Wilde, London. Process for rendering mineral phosphates capable of being assimilated by plants. July 8

COMPLETE SPECIFICATION ACCEPTED.

1886.

6857 J. Van Ruymbeke. Converting the waste liquids of rendering and like establishments into fertilisers and other useful products. July 20

XV.—SUGAR, GUMS, STARCHES, ETC.

APPLICATIONS.

8537 J. Schwartz, jun., Chislehurst. Improvements in the manufacture of lump sugar. June 29
 9246 C. Lyle and J. Lyle, London. Improvements in the manufacture of lump sugar. July 16
 9217 C. Lyle and J. Lyle, London. Improvements in the manufacture of lump sugar. July 16

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

9219 A. G. Wass, London. The improved utilisation of sugar scum. June 25
 10949 E. Fielding. Apparatus for automatically regulating the flow of wort and other liquids from coolers. July 16

1886.

7186 F. Bauder. Manufacturing perforated or figured sugar tablets or blocks. June 29

XVI.—BREWING, WINES, SPIRITS, ETC.

APPLICATIONS.

8420 A. Boake and F. G. A. Roberts, Stratford. The application of an improved antiseptic salt in brewing. June 26
 9090 A. W. Gillman and S. Spencer, London. Improvements in means or apparatus employed in the preparation of finings for the use of brewers and others. July 12
 9131 H. W. Lafferty, London. Improvements in the utilisation of the refuse or slops of breweries, distilleries, starch factories, etc. Complete specification. July 20

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

11153 E. J. Fraser. Treating wines and liquors by electricity, and apparatus therefor. July 2

1886.

16 H. N. Eckel. Production of non-alcoholic and unfermented wines, drinks, etc. June 25
 7225 P. M. Justice—Communicated by J. D. Hazlett and W. R. Bennett. Apparatus for automatically supplying gas to beer or like beverages. July 13

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, ETC.

APPLICATIONS.

A.—CHEMISTRY OF FOODS.

8233 F. I. Fitzgerald, London—Communicated by R. M. Boyd, Australia. Improvements in food for horses, cattle, poultry, and other like stock. June 22
 8645 H. W. Hart, London. An improved method of treating coffee to prevent loss of its valuable constituents and to preserve the aroma. July 1
 9322 F. P. Warren, East Greenwich. An improved food for animals. July 17

B.—SANITARY CHEMISTRY.

8111 C. Georgi, London. Improvements relating to the treatment of refuse liquids of gas-works, sewage, and similar substances for the production of manure. June 25
 8169 F. H. Danchell, London. Improvements in the manufacture of charcoal from sewage, sludge, and other matters. June 28
 8871 J. Bannchr, Budleigh-Salterton, Devon. Improvements in the method of treating sewage and other polluted waters. July 7
 8905 S. Vickers. See Class I.
 9227 J. S. Sawrey, London. Improvements in means for softening and purifying water. July 15
 9276 Bohlig and Heyne. See Class VII.

C.—DISINFECTANTS.

8509 A. Boake and F. G. A. Roberts, Stratford. Improvements in disinfectants. June 29

COMPLETE SPECIFICATIONS ACCEPTED.

A.—CHEMISTRY OF FOODS.

1886.

7035 J. N. Beach. Dietetic compounds. July 2
 7613 F. A. Thyss—Communicated by N. Moes. Apparatus for cooling milk and separating cream therefrom. July 23

B.—SANITARY CHEMISTRY.

1885.

10879 C. T. Kingzett, London. Treatment and utilisation of sewage. July 9
 11542 T. H. Cobley. Manufacture of vitriolised ash, and application of same to the deodorisation and purification of polluted water and refuse matters. July 9
 11136 C. T. Kingzett. Treatment and utilisation of sewage. July 23

1886.

7174 H. Fewson. Treatment of sewer and other similar noxious gases. July 13

C.—DISINFECTANTS.

1885.

- 10212 P. Ockenden—Communicated by H. Locke and H. T. Tompsett. Antiseptic, deodorant, and disinfectant compound. July 16
10876 E. B. Watson and H. B. Fulton. Preparation of hygienic and disinfecting substances, as candles, night-lights, etc. July 20

XVIII.—ELECTRO-CHEMISTRY.

APPLICATIONS.

- 8226 A. M. Clark, London—Communicated by A. E. Peyrusson, France. Improvements in secondary batteries or accumulators. June 22
8248 A. R. Bennett, Glasgow. Improvements in insulators for supporting electrical conductors. June 22
8346 A. B. Blackburn, London. An improvement in dynamo-electric machines. June 24
8355 Ch. E. L. Brown, London. Improvements in the armature for dynamo-electric machines. June 24
8379 A. Reckenzaun, London. Improvements in secondary batteries or electrical accumulators. June 25
8497 A. F. St. George, Redhill. Improvements in apparatus for generating and utilising electricity. June 29
8501 W. L. Gates, London. Improvements in portable galvanic batteries. Complete specification. June 29
8542 E. Fürst, London. A process and apparatus for electrolytic treatment of certain double chlorides. June 29
8564 G. Baron de Overbeck. See Class X.
8620 G. E. Norman, Stafford. Improved construction of thermo-electric batteries. July 1
8688 G. T. Tugwell, London. Improvements in armatures for electric generators or electro-motors. July 2
8693 W. J. Sharkey-Barber-Starkey, Bridgnorth. The use of a new electrolyte in secondary cells. July 2
8832 A. Schanschiff, London. A novel saline preparation applicable for use in galvanic batteries, and the process for the manufacture of the same. July 6
9013 R. Ranschke, Halifax. Improvements connected with electric batteries for increasing the power thereof. July 10
9056 W. Maxwell, Fulham. Improvements in the construction of dynamo-electric machines. July 12
9085 V. Sass & K. Friederich, London. Improvements relating to electric accumulators or secondary batteries. July 12
9088 R. H. Courtenay, London. Improvements in the construction and arrangement of electric cells, particularly applicable to gravity batteries. July 12
9214 F. E. Elmore, London. New or improved means and apparatus for the manufacture and coating or covering various metal wares by combined electro-chemical and mechanical process. July 15
9228 W. Brakefield, London. Improvements in apparatus for generating electricity by means of heat. July 15
9351 W. H. Akester, London. Improvements in or relating to secondary batteries. July 19
9403 A. J. Boulton—Communicated by O. Lugo, United States. Improvements in galvanic batteries. Complete specification. July 20
9492 H. Leipmann, London. Improvements in the process for treating auriferous substances by electrolysis. July 20
9478 J. A. Fleming, London. Improvements in dynamo-electric machines. July 21
9514 E. H. Desola, London. Improvements in galvanic batteries. July 22
9518 R. Applegarth, London. Improvements in the manufacture of carbon electrodes. July 22

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 8574 H. R. Cassel. Process and apparatus for treating metals, alloys, and especially auriferous ores, by electrolysis. July 2
9601 H. W. Ravenshaw. Electro-magnets, and application of the same to the control of electric currents. July 9
9688 H. Lindley. Driving gear for dynamos. July 9
9706 C. D. Abel—Communicated by J. C. Purthner. Method and apparatus for producing induced electric currents. July 20
12378 A. Schanschiff. Galvanic batteries, and preparation of liquids to be used therein. July 16

1886.

- 2647 L. N. Loeb—Communicated by J. H. Howard. Galvanic batteries. June 25
2648 L. N. Loeb—Communicated by J. H. Howard. Galvanic batteries. June 25
7426 C. Petri. Production of the ferri-cyanides of potassium, sodium, and ammonium by electrolysis. July 13

XIX.—PAPER, PASTEBOARD, ETC.

APPLICATIONS.

- 8214 W. Brierley, Halifax—Communicated by F. Leidl, Germany. Improvements in the preparation and manufacture of paper, specially applicable for lithographic purposes and uses, tracing, and transferring. June 22

- 8447 W. Heilgers, London—Communicated by J. E. D. Wise, India. Improvements relating to the treatment of reha or China grass, and to machinery or apparatus therefor. June 26
8486 H. J. Haddan, London—Communicated by W. Wärn, Sweden. A new or improved rotating vat, principally for the boiling of cellulose. June 28
8493 A. Wilkinson, London. Improvements in the manufacture of paper pulp, papier mache, and also combination of chemicals for pulping and whitening and bleaching the same. June 28
8594 H. T. Breidahl, London. An improved method to separate the liquor from the solid substances of spent wash, spent fibre, and similar materials. June 30
8936 E. Davies and H. F. Harris, London. An improved treatment of spent hops, and apparatus therefor, for the production of pulp suitable for the manufacture of paper and millboard. July 8
9178 A. J. Boulton—Communicated by A. Ubbelohde, Hanover. Improvements in the manufacture of paper pulp from moss peat. July 14
9336 D. Lindo, London. Improvements in or connected with the manufacture of paper. July 17
9358 E. Musil, London. Improvements in the manufacture or preparation of paper for bills of exchange, cheques, and the like. July 19

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

- 4934 J. B. Scammell. Manufacture of paper for cigarettes. July 6
6554 W. Tijen. Steam jacketed boilers for converting wood and other fibre into pulp suitable for manufacture into paper, etc. July 16

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

APPLICATION.

- 8463 W. Merck, London. Improvements in the production of peptone from nucleo-proteins. June 28

COMPLETE SPECIFICATION ACCEPTED.

1886.

- 6899 S. Waters. Tonic bitters.

XXI.—EXPLOSIVES, MATCHES, ETC.

APPLICATIONS.

- 8368 T. Johnston and G. Smith, Glasgow. Improvements in detonators or caps to be used with dynamite or other explosive. June 25
8736 C. J. D. Oppermann, London. A detonating fire alarm. July 3
8791 J. Murrie, Glasgow. Improvements in apparatus for utilising the expansive force of vapour for throwing projectiles and the like. July 6
9166 C. Roth, London. Improvements in the manufacture of explosives. July 11
9258 S. Baynes, Glasgow. Improvements in and connected with the igniting of charges of gunpowder and other explosives. July 16

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 8313 D. R. Dawson, Glasgow. Improvements in and connected with explosive projectiles, and in part applicable for extending electrical communicating lines. June 25
11215 J. Graddon and P. Harding. Means and substances for producing an explosive agent, and employment thereof for working engines.
13938 R. Bell. Wax matches and vesta fuses. July 13

1886.

- 7407 A. M. Clark—Communicated by H. J. Smith. Electric fuses for pyrotechnical and other purposes. July 2

XXII.—GENERAL ANALYTICAL CHEMISTRY.

COMPLETE SPECIFICATION ACCEPTED.

1885.

- 8610 C. G. P. de Laval. A new method of and apparatus for determining the quantity of fat in milk. July 9

THE JOURNAL OF THE Society of Chemical Industry:

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NOTICE.

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Should sufficient applications for complete sets be received, the number will be reprinted.

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Deaths.

E. R. Southby, 1/o 24, Holborn Viaduct, London, E.C.
O. W. G. Trenow, 1/o Helston Lodge, Croydon; at Liverpool, August 12.

Communication.

ON THE COMPOSITION OF THE COAL OF THE SOUTH STAFFORDSHIRE COAL-FIELD.

BY E. W. T. JONES, F.I.C.

Owing to the kindness of the late Mr. W. Bowkley, who personally selected all the samples, I am enabled to give analyses of representative specimens of all the various seams of coal met with in the South Staffordshire coalfield. The results, as tabulated on p. 445, to make them thoroughly comparable, are all on the coal dried c. 212° F., and it must be remembered the samples were all clean or free from extraneous earthy matter. The coal nearest the surface is placed first on the list, and that farthest from the surface last. See section as at Coseley, which is about the centre of the South Staffordshire coalfield.

		Thickness.
		ft. in
Brooch Coal		3 9
Flying Red Coal		4 0
THICK COAL	White Coal	2 6
	Tow Coal	2 9
	Brazils	2 0
	Foot Coal	1 9
	Bat	2 0
	Slips Coal	2 6
	Stone Coal	2 3
	Patchels Coal	1 6
	Sawyer Coal	2 6
	Slipper Coal	2 0
	Bat	2 0
	Benches Coal	2 0
Heathen Coal		3 3
New Mine Coal		6 0
e-clay Coal		5 6
Bottom Coal		4 0

NOTE.—Flying Red Coal, West of Dudley, lies close upon and is part of the Thick Coal, and is called Top Slipper and Roofs.

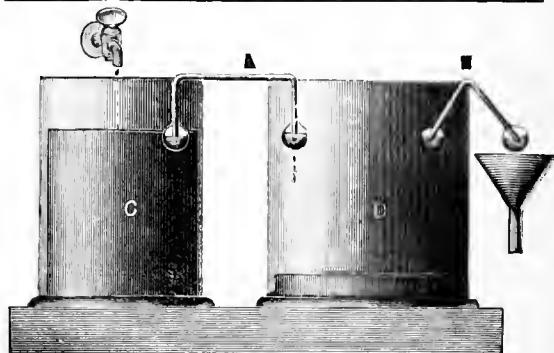
I wish to record my thanks to my assistant, Mr. A. E. Johnson, A.I.C., for his careful work in connection with the deduction of the foregoing results.

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

New Form of Syphon. F. W. Dafert. Chem. Zeit. 10, 821.

THE accompanying figure shows a very convenient form of syphon, which hardly requires description. The cups at each end of the syphon require to have more than twice the capacity of the syphon tube. To start the syphon, it is only necessary to fill one cup with liquid,



then to lower the other until the liquid reaches it; then, on bringing the cups to the same level, the syphon is charged and ready for work. The figure shows an arrangement by which the syphon prevents the overflowing of a couple of vessels, C and D.—J. T.

Improvements in Filters. James and John Clayton, Manchester. Eng. Pat. 8986, July 25, 1885. 8d.

THE improvements described relate to filters formed from porous sandstone, and consist in making the filtering vessel cylindrical, cut from a single piece of stone. One or both ends may be cemented on by Portland or other cement.—C. C. II.

Improvements in Filter-presses. D. K. Clark and W. J. E. Foakes, London. Eng. Pat. 9204, July 31, 1885. 8d.

THE plates of the filter-press may be made from a sheet of wrought iron, to which a rim is rivetted, perforated or sub-channelled radially so as to afford an easy escape for the filtrate round the entire circumference; or the plates may be cast with radial drainage grooves, a plain rim covering them at the circumference, rivetted thereto, affording a similar exit for the filtrate as in the first plan described.—C. C. II.

Improvements in Filters. A. Bell, Manchester. Eng. Pat. 9959, August 22, 1885. 8d.

AN earthenware vessel is separated at its centre by a ledge upon which is placed a diaphragm, and resting thereon a carbon filtering block, covered in its turn by a shield; the whole is held down by a spring clip. The lower part of the vessel forms a reservoir for the filtered water which has passed through the carbon block, and the upper part acts as a reservoir for the unfiltered water. When the block of carbon has become foul it can be removed and either cleansed or replaced.—C. C. II.

* Any of these specifications may be obtained by post, by remitting the cost price, plus postage, to Mr. H. Reader LACK, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

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Reichling's Electrical Safety Apparatus for Steam Boilers. Chem. Zeit. 10, 822.

THE diagram on p. 446 illustrates the apparatus. This consists of a tube, about 40mm. internal diameter, the lower, open end of which stands at the lowest permissible water-level in the boiler, and the upper end of which stands about 1½m. above the boiler. This upper end contains a double-seat valve, the seats of which are of equal diameter. The ribbed H-shaped valve has about 2mm. play between the two seats, and is pressed down on to the lower seat by means of an internal easily-fusible ring, which is again controlled by a terminal bush, screwed internally. The movable valve carries an isolated junction plate, whilst the terminal bush carries two isolated binding screws.

When the water is at the normal level the tube is filled with cooled water; but if the water runs short the tube becomes filled with steam, and the fusible ring is melted. The valve is now pressed against its upper seat, thus preventing further escape, and electrical contact is made at the same time between the binding screws. The alarm

An Improved Filter. C. I. C. Bailey, Fulham. Eng. Pat. 2472, February 19, 1886. 6d.

THE apparatus consists of a tube passing through two plates, between which the filtering medium is placed. Round the lower end of the tube, which is perforated, a conical block of carbon is placed, and this is surrounded by loose charcoal. The water passes through the upper plate, which is perforated, through the charcoal and carbon block, by the holes into the tube, and so into the reservoir for filtered water. The filtering medium can be readily replaced, and the filtered water is in contact with the air.—C. C. H.

II.—FUEL, GAS, AND LIGHT.

Claus's Ammonia Process of Gas Purification. C. Hunt (Proc. Gas Institute). J. Gas Lighting, June 22, 1886, 1181—1191.

IT will be seen by the drawings on pp. 147 and 148 that the plant consists of a number of scrubbers and towers, all

KIND OF COAL.	Thickness of Seam.	Sp. Gr.	PERCENTAGE ON COAL DRIED AT 212° F.				COLOUR OF ASH.
			Volatiles Matter.	Fixed Carbon.	Sulphur.	Ash.	
I. BROOCH COAL.....	ft. in. 3 9	1.282	38.55	59.02	0.83	1.60	Light buff
II. FLYING RED COAL.....	4 0	1.278	40.05	59.63	0.62	1.70	Buff of yellow tinge
III. THICK COAL—							
1. White.....	2 6	1.289	39.00	59.53	0.37	1.10	Flesh colour
2. Tow.....	2 9	1.294	31.70	63.53	0.22	1.55	Buff colour
3. Brazil.....	2 0	1.261	40.20	58.07	0.43	1.30	Nearly white
4. Foot.....	1 9	1.285	41.65	55.27	0.53	2.55	White
Between this and the next			beneath a	layer of	"Bat" 2 feet thick		intervenes.
5. Slips.....	2 6	1.272	37.30	59.36	0.54	2.80	Flesh colour
6. Stone.....	2 3	1.271	39.95	57.50	0.65	1.90	Dark buff
7. Patchels.....	1 6	1.286	39.50	56.94	0.86	2.70	White
8. Sawyer.....	2 6	1.281	40.80	56.64	0.51	2.05	Nearly white
9. Slipper.....	2 0	1.280	37.60	60.11	0.65	1.60	" "
10. Benches.....	2 0	1.294	39.60	51.61	1.59	1.20	Light red
IV. HEATHEN COAL.....	3 3	1.283	39.70	57.51	0.59	2.20	Nearly white
V. NEW MINE COAL.....	6 0	1.281	39.00	57.60	1.00	2.40	" "
VI. FIRECLAY COAL.....	5 6	1.300	38.25	55.12	0.93	5.65	" "
VII. BOTTOM COAL.....	4 0	1.287	38.30	56.30	1.65	3.75	Light red

current thus set up by means of a small battery can be made to indicate the condition of the boiler in any desired place. There are no moving parts within the boiler. The fusible ring is loaded with the boiler pressure, so that its destruction, when heated, is certain. The ring, contact plate, and poles are protected both from the influence of the boiler and of the air, thereby ensuring certainty of action.—J. T.

Improvements in and connected with Filter-presses. J. A. Drake and R. Muirhead, Maidstone. Eng. Pat. 10,143, August 27, 1885. 8d.

THE improvements specified relate to the mode of forming the chambers in filter-presses used for materials such as sludge or slurry. Wrought-iron slotted plates are covered with coir, bass, or like fibre, which is laced on through the slots in the form of cord or plait so as to cover the surface of the plate; it may also be applied previously woven. These are placed between distance rings which overlap them, forming a fillet or recess into which the liquid exuding from the "filtering mat" passes and is carried away.—C. C. H.

of which are square in shape, with the exception of the last scrubber. The scrubbers in which the gas is purified are marked A₁, A₂, A₃, A₄, and A₅. Five of them are 4 feet square and 20 feet high, and are filled with broken ganister bricks supported on crossed angle irons, the liquor being distributed at the top of each by a tumbling box arrangement. The sixth scrubber is of the Mann and Walker type; it is 5 feet in diameter and 25 feet high, and serves as catch-vessel, being supplied for the purpose with spent liquor from the tower C₁. The foul gas, having previously passed through a Livesey washer, travels up the scrubber A, and then descending enters at the bottom of A₂, towards the top of which it meets with ammonia gas from the distilling towers; it then passes up through A₃, A₄, A₅, and A₆ in succession, being entirely freed in its passage from carbonic anhydride and sulphuretted hydrogen, whilst of ammonia there remains at the outlet of the last scrubber only the usual faint traces, and the carbon disulphide is reduced by from 20 to 70 per cent. Parallel with the scrubbers are placed eight towers, 2 feet square and 18 feet high. Five of these—B₁, B₂, B₃, B₄, and B₅—are decomposing

towers, and the remaining three—C, C₁, and C₂—distilling towers. In the B towers the scrubber-liquor is heated to a carefully-regulated temperature to expel the carbonic anhydride and sulphuretted hydrogen with as little loss of ammonia as possible. B is a washing or catch tower, supplied with spent liquor at the rate of about 40 gallons per hour, in which is retained any ammonia that the acid gases may bring with them from B₁. The strong liquor from scrubber A enters the tower B₁ (which, together with B₂, is further distinguished as a carbonating tower), and mingles with the spent liquor

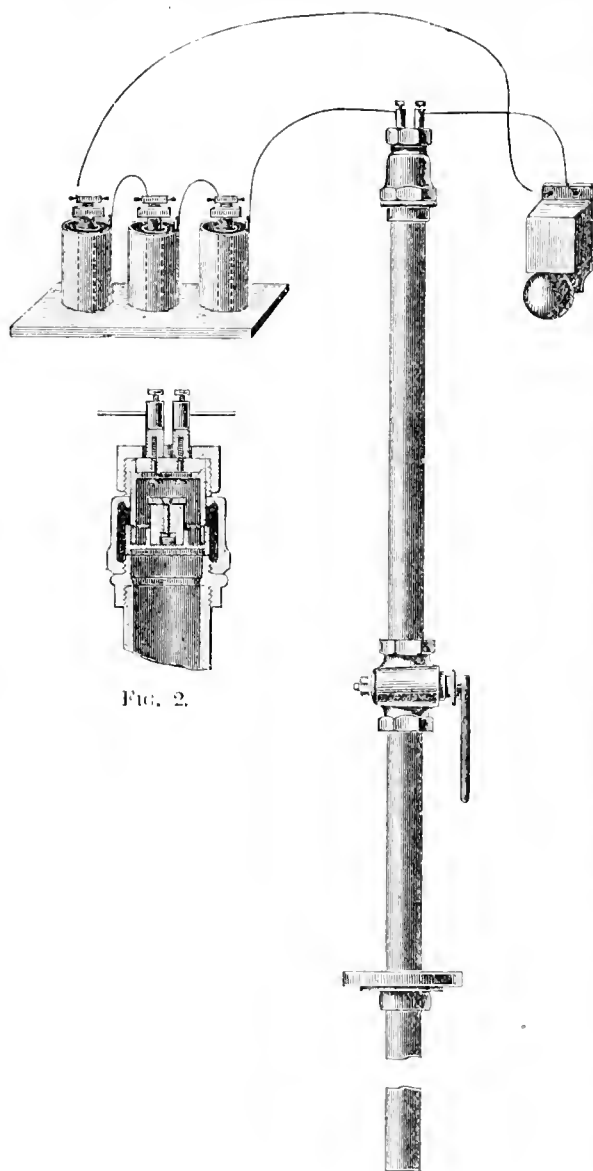


FIG. 2.

FIG. 1.

after this has passed through the tower B, becoming almost supersaturated with the acid gases which are on their way to B. The temperature of this tower is very little above that of the air, and the liquor passes from thence to tower B₁, the temperature of which varies from about 71° at the bottom to about 38° at the top. The sulphuretted hydrogen is by this means wholly, or almost wholly, expelled, and the ammonia obtained as ammonium carbonate, which may be drawn off at the bottom of B₁. If desired, automatic production of ammonium sulphate may be set up by the substitution for the wash

ing tower B of an acid saturator, through which the gases would pass on their way to the sulphur kiln, D, and to which the surplus ammonia might be conveyed from B₂. In the next towers—B₃ and B₄—which are the heating towers of the series, the actual separation is effected; both are fitted with horizontal cast-iron trays, thirty in each tower, in which are placed wrought-iron steam coils. The liquor enters at the top, and falls from tray to tray, rising gradually in temperature to from 80° to 85°. This drives ammonia forward to B₅, but it is all returned. In B₅, which is constructed in a similar manner, the temperature varies from 87° at the top to 90° at the bottom where the steam enters. The liquor from this tower, which is mainly liquid ammonia, is ready for distillation in towers C, C₁, and C₂. These are, in reality, scrubbers filled with broken ganister. From the bottom of B₄ the liquor passes to the top of C, meeting in its descent the vapours and gases given off in C₁. At the base, it attains a temperature of about 100°, by which the greater part of the ammonia (except that in the form of thiocyanate), carbonic anhydride, and sulphuretted hydrogen still remaining in combination are expelled. These, together with a considerable quantity of vapour, are driven forward to C₂. To liberate the fixed ammonia an equivalent proportion of caustic soda is mixed with the liquor. The heat of the waste liquor is utilised in raising the temperature of the strong liquor from the scrubber A, or of the feed-water for boilers by passing it through a series of jacketed tubes. From the top of C the hot vapours enter at the base of C₂, into which no liquor is pumped; they are there partly condensed, the temperature in the tower ranging from about 86° at the bottom to about 44° at the top, and the liquor which accumulates therein, and consists of ammonium carbonate and some free ammonia, is pumped into B₄. The average strength of this liquor is nearly ten ounces. Ammonia gas, with some carbonic anhydride, is conveyed by a pipe from the top of this tower to the top of the scrubber A₁, where it meets the foul gas already once washed in A and A₁. The last operation relates to the acid gases which, after passing through the washing tower B, are conveyed to an apparatus for the recovery of sulphur, consisting of a kiln, K, built of cast-iron tank plates lined with fire-brick and filled with oxide of iron, a depositing chamber, D, a wash tower filled with pebbles and surplus spent liquor, and an open oxide purifier. The gases from B consist of about 40 per cent. of sulphuretted hydrogen and 60 per cent. of carbonic anhydride. With these an equal volume of air is mixed, and the mixture passed through a 15-inch bed of oxide of iron heated to redness in the kiln K. By this means sulphur is set free in a state of vapour, which, together with the gases, passes into D, where the sulphur settles out. To prevent the escape of unaltered sulphuretted hydrogen, or of sulphurous anhydride formed, of both of which there is generally a small quantity present in the gases leaving D, the latter are passed through a 2-feet wash tower, and then into an open purifier. The exit gases from this consist of carbonic anhydride and nitrogen. From 10 to 14 lb. of pure sulphur is stated to be obtained per ton of coals carbonised.

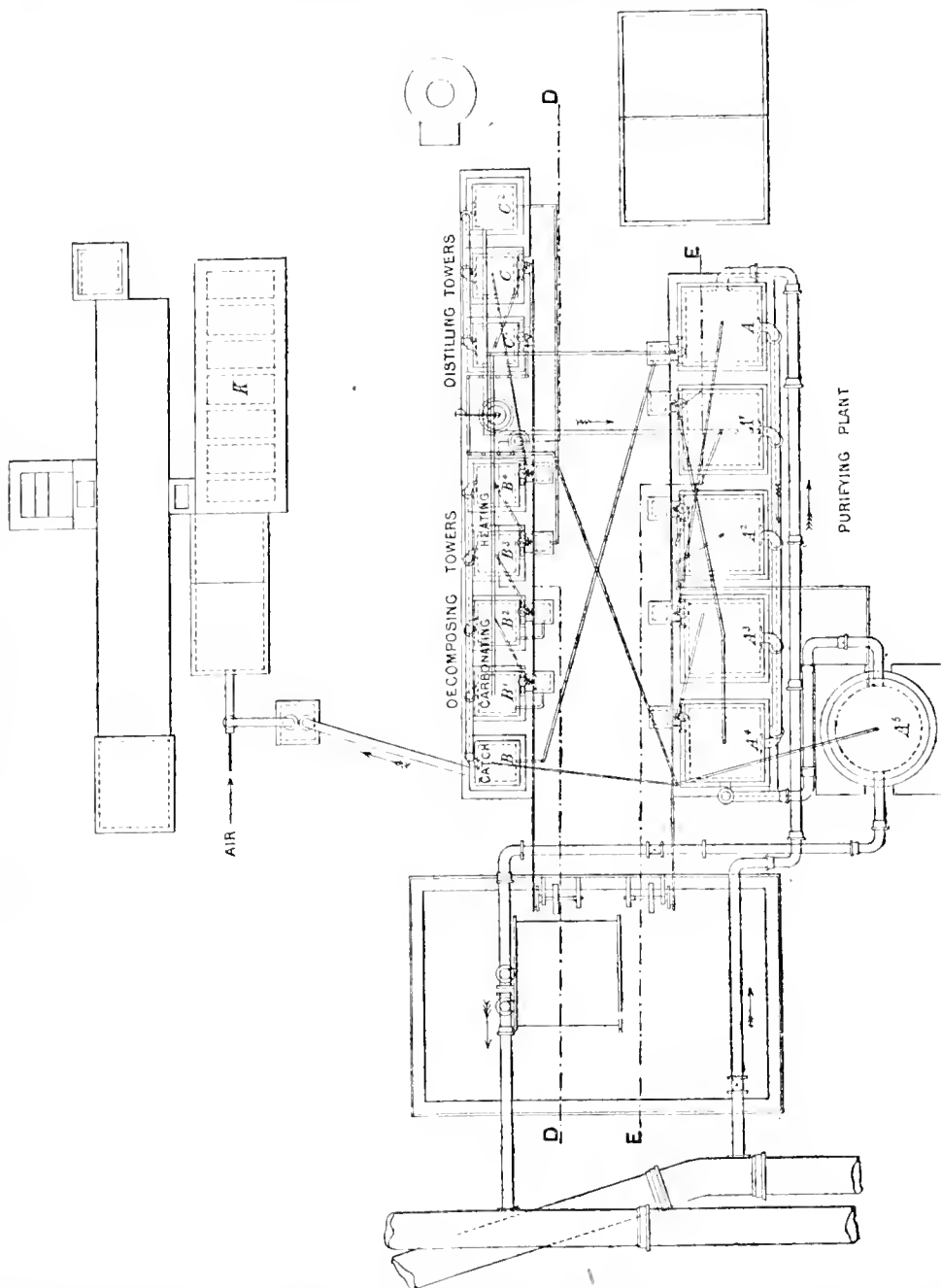
This apparatus, which has been erected at the Windsor Street station of the Birmingham Gas Works, is said to compare favourably, as regards occupation of ground-space, with the ordinary system of dry purification. It is capable of purifying about 250,000 cubic feet of gas daily, requiring only the attendance of one man by day and another by night. As the success of the method depends largely on the proper working of the pumps, it would be desirable to provide them in duplicate. The loss of ammonia is estimated at about 10 per cent. of the quantity actually passed through the apparatus, which, being about one-third of the entire quantity produced, is equal to a little over 3 per cent. of total loss.

It was stated above that the spent liquor which is pumped over the scrubber A₂ is derived from the free steam used in the distilling towers. Of this, as of the ammonia, there is, however a surplus, which is collected in a tank holding about 24 hours' make. This contains thiocyanate and ferrocyanide of sodium; to it a solution of a salt of iron is added, a precipitate of iron ferrocyanide being formed, which is either Prussian blue or can readily

be converted into it. The clear liquor from this precipitate is drawn off and pumped through the sulphur wash tower, where it becomes impregnated with sulphurous acid. Sulphate of copper is then added to the solution, whereby insoluble cuprous thiocyanate is formed. After settling, the clear liquor containing sulphate and chloride of sodium is run away. One ton of coal yields about $\frac{1}{2}$ lb. of Prussian blue and $\frac{1}{4}$ lb. of copper thiocyanate.

the by-products from the waste liquor, which are at present entirely lost to gas suppliers. The only disadvantage of the apparatus is that the sulphur compounds are not sufficiently reduced to come regularly within the standard required by the London Gas Referees. This is illustrated by the following results:—160,000 cubic feet of gas passing per diem contained 143 grains of ammonia per 100 cubic feet, 2.95 per cent. of sulphuretted hydro-

AMMONIA GAS PURIFYING PLANT—CLAUS'S PROCESS.



The advantages of this process may be summarised as follows:—(1.) The recovery of the sulphur in the solid form, in which state its value must be much greater than when combined with iron oxide. (2.) The saving of oxide of iron and lime, together with the labour required for their preparation. (3.) The production of the surplus ammonia in a much more marketable form than when obtained as ordinary gas-liquor. (4.) The recovery of

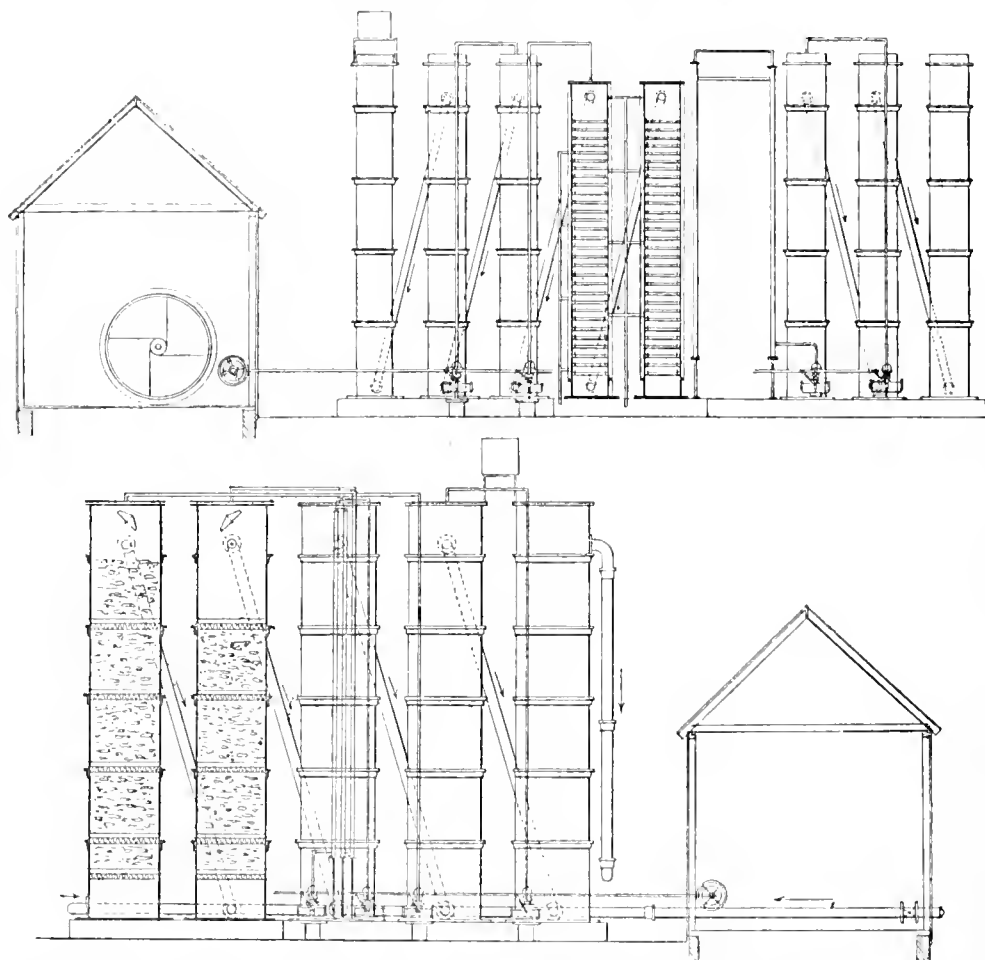
gen, and 2.04 per cent. of carbonic anhydride in the crude state; the purified gas containing 3.39 grains of ammonia, no sulphuretted hydrogen, no carbonic anhydride, and the sulphur compounds reduced to from 28 to 21 per cent.

The author recommends that until a larger proportion of the sulphur compounds can be removed, the working of this process on a large scale should not be undertaken.

without purifiers to fall back upon. By passing either the foul gas or the acid gases diverted from the sulphur kiln through catch purifiers charged with lime, the ear-

meets the liquid hydrocarbon, and transforming this into vapour passes along with it through the outlet pipe for combustion under the boiler or elsewhere.—A. R. D.

AMMONIA GAS PURIFYING PLANT—CLAUS'S PROCESS.



bonic anhydride would first be arrested and the sulphuretted hydrogen allowed to go forward and form calcium sulphide.—D. B.

Apparatus for Conversion into Gas and Combustion of Liquid Hydrocarbons. O. Imray, London. From J. B. Archer, Washington, U.S.A. Eng. Pat. 6347, May 11, 1886. 6d.

THIS apparatus consists of a vertical cylindrical boiler with a firebox beneath, communicating with a heating chamber above, by means of a flue, running vertically upwards through the centre of the boiler. In this heating chamber a water pipe, disposed in any number of coils, for heating the boiler feed-water, and a coil of steam pipe, are situated, wherein steam taken from the upper part of the boiler is superheated before entering the gas generator. This last consists of a spherical chamber from which a pipe projects downwards into a hollow casing. An oil supply-pipe delivers liquid hydrocarbon into the body of the chamber, and an outlet pipe from the top of this latter forms a means of exit for the gas produced. The generator, with its outer casing, is situated partly within and partly above the central vertical flue, so that it is heated by the products of combustion passing upwards from the firebox. Steam is forced into the hollow casing of the generator where it is superheated, and whence it passes upwards through the pipe above-mentioned into the spherical chamber. Here it

Improvements in Appliances for increasing the Illuminating Effect of Gas. Jas. Maclear, London. Eng. Pat. 6811, May 20, 1886. 4d.

THIS invention relates to increasing the luminosity of a flame by heating therein a material capable of becoming incandescent. The materials used are strontia, baryta, thorium and zirconia. Cotton wicks or wicks of other fibrous material are employed as vehicles for carrying the incandescent bodies. They are wound or twisted round a thin platinum wire into suitable forms, such as spiral, helical, etc., and are then saturated with a solution of strontia, for instance. When dried and ignited they are ready for use.—A. R. D.

III.—DESTRUCTIVE DISTILLATION. TAR PRODUCTS, Etc.

Thionaphthen. V. Meyer. Ber. 19, 1432.

By the condensation of thiophen aldehyde (Ber. 19, 636) with succinic acid, according to Fittig's method, Biedermann obtained, in the author's laboratory, the α naphthol of the thiophen group—*hydroxythionaphthen*, $C_8SH_6.OH$. This substance closely resembles α -naphthol in properties and reactions, and is described in the next abstract. The author is experimenting on the conversion of conmarone $C_{10}H_8O$ into thionaphthen C_8SH_6 by the action of phosphorus trisulphide.—D. B.

Thiophenol and α-Naphthol of the Thiophen Group.
A. Biedermann. Ber. 19, 1615—1620.

HITHERTO it has been impossible to obtain the phenol of thiophen; the author has, however, prepared its thiophenol—*thienylmercaptan*, C_4SH_3 —SH. For this purpose thiophen was converted into thiophenmonosulphonic acid, $C_4SH_2SO_3H$, and this into thiophensulphonic chloride, $C_4SH_2SO_2Cl$. The latter was then subjected to the action of zinc-dust, in order to obtain thiophensulphinic acid, according to the method adopted by Otto for preparing benzenesulphinic acid (Ber. 10, 939). The zinc-salt of the thiophensulphinic acid was gradually introduced into a mixture of granulated zinc and hydrochloric acid, thienylmercaptan being formed. It is a pale-yellow oil, having a disagreeable odour, resembling that of phenylmercaptan, and boils at 166° (uncorr.). On exposure to the air it gradually solidifies to a crystalline mass, which is probably *thienyldisulphide*, $C_4SH_3 \cdot S \cdot S \cdot C_4SH_3$. Thienylmercaptan yields azo-dyes with diazo-compounds, and in this respect differs from phenylmercaptan, which does not react with diazo-compounds.

Hydroxythionaphthen, $C_{10}SH_7OH$, was prepared by heating a mixture of 6·8 grms. of thiophenaldelyde, 10 grms. of finely-powdered sodium succinate (dried at 140°), and 6 grms. of acetic anhydride to 135° , dissolving the product in dilute caustic soda, extracting the unattacked aldehyde with ether, and precipitating the naphthol in the alkaline solution with hydrochloric acid. It crystallises from alcohol and ether in long white needles, which melt at 72° , sublimes in the same crystalline form, is sparingly soluble in water, but dissolves freely in dilute alkalis. A number of characteristic colour reactions are given.

The alcohols of thiophen known at the present time are—

Nitrothiēnol, $C_4SH_2(NO_2)(OH)$. (Meyer and Stadler.)
Thienylalcohol, $C_4SH_2CH_2OH$. (Biedermann.)
Thiēnol (methylthiēnol), $C_4SH_3(CH_3)(OH)$. (Paal.)
Hydroxythionaphthen, $C_{10}H_7(C_2SH_2)(OH)$. (Biedermann.)—D. B.

On Pyrene. E. Bamberger and M. Philip. Ber. 19, 1427—1431.

It has been demonstrated by Graëbe that pyrenequinone belongs to the class of diketones. From investigations of Hinsberg's reaction for ortho-diketones—namely, their property to form quinoxalines with ortho-diamines (this Journal, 1885, 511)—and from the colour reaction exhibited by ortho-diketones with alcoholic potash (this Journal, 1885, 370), the authors infer that pyrenequinone does not contain the two carbonyl groups in direct combination with one another.

Pyrenic Acid, $C_{15}H_8O_5$.—On oxidising pyrene with chromic acid, Hintz and Goldschmidt obtained, besides pyrenequinone, a substance soluble in sodium carbonate, having the formula $C_{15}H_8O_5$. The authors now find that this body, as analysed by these chemists—*i.e.*, recrystallised from glacial acetic acid—has the formula $C_{15}H_8O_4$ assigned to it. During the process of recrystallisation, however, the original substance, which is separated from the soda solution by the addition of an acid, is changed in chemical constitution, being deprived of water. The composition of the product obtained by direct precipitation is $C_{15}H_8O_5$; it is a well-defined acid, which the authors have named *pyrenic acid*. When heated to 120° , or recrystallised from glacial acetic acid, the anhydride $C_{15}H_6O_4$ is obtained. Pyrenic acid separated from its saline solutions by means of an acid, forms gold-coloured shining laminae; its anhydride crystallises from glacial acetic acid in short yellow needles having a vitreous lustre. The acid is dibasic, as proved by the constitution of the silver and barium salts; hence, the formula $C_{15}H_8O_5 = C_{15}H_6O(COOH)_2$, whilst the ease with which the anhydride and imide are formed affords proof to the ortho-position of the two carboxyl groups; hence, the acid $C_{15}H_8O_5 = C_{15}H_6O(COOH)_2[CO_2H:CO_2H = 1:2]$, and the anhydride $C_{15}H_6O_4 = C_{15}H_6O \begin{Bmatrix} CO \\ CO > O \end{Bmatrix}$. By dissolving the acid in ammonia, and heating the solution

gently, a yellow precipitate is obtained, which is the imide of pyrenic acid, having the formula $C_{15}H_7O_3N = C_{15}H_6O \begin{Bmatrix} CO \\ CO > NH \end{Bmatrix}$. —D. B.

Improvements in treating Hydrocarbon Bodies or Substances. J. K. Field, London. Eng. Pat. 10,139, May 27, 1886. 6d.

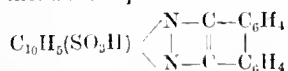
THIS is a process for purifying either solid or liquid hydrocarbons such as earthwax, paraffin seal, or mineral lubricating oil. The material is freed from water and dirt preferably by heating over an open fire, and is then agitated with fuming sulphuric acid. It is next freed from acid, and digested with a suitable solvent such as naphtha in the presence of say fifteen per cent. of bleaching material or decolorant such as bone-black. After settling out, the clear solution is run off and treated with more decolorant. The naphtha is now distilled off, and the solid residue again acidified and treated with decolorant, which leaves it thoroughly bleached. In some cases the acidifying may be dispensed with, and, with mineral oil, the addition of a solvent is not always required.—A. R. D.

IV.—COLOURING MATTERS AND DYES.

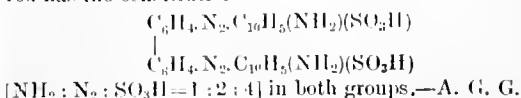
Constitution of α-Naphthylaminesulphonic Acid (Naphthionic Acid) and of Congo-red. O. N. Witt. Ber. 19, 1719—1722.

CLÈVE has already shown that α-naphthylaminesulphonic acid probably has the constitution $C_{10}H_7(NH_2)(SO_3H)$ [$NH_2:SO_3H=1:4$], for by treatment with phosphorus pentachloride it is converted into dichloronaphthalene, of melting-point $67\cdot5^\circ$. As this proof is not quite beyond doubt, a further confirmation of the formula appeared desirable. This was afforded by the reaction of the acid with diazo-compounds. As is well known, when phenols, amines, or their sulphonic acids are combined with diazo-compounds, the diazo-residue takes by preference the para position to the OH or NH_2 group; but when this place is already occupied it takes an ortho position.

α-Naphthylaminesulphonic acid readily combines with diazo-compounds, and if it has the constitution assigned to it by Clève, these azo-products will have the formula $C_{10}H_5(NH_2)(N_2R)(SO_3H)$ [$NH_2:N_2R:SO_3H=1:2:4$], and will give on reduction *o*-naphthylenediaminesulphonic acid, $C_{10}H_5(NH_2)_2(SO_3H)$ [$NH_2:NH_2:SO_3H=1:2:4$]. Of these azo-compounds, the one selected for examination was Congo-red, which is formed by the combination of tetrazodiphenyl with α-naphthylaminesulphonic acid. The aqueous solution of the dyestuff is readily reduced by the addition of ammonia and zinc-dust. On cooling, benzidine crystallises out, and the solution contains *o*-naphthylenediaminesulphonic acid. The latter was not isolated, but was identified as an ortho-diamine by its capability of giving a quinoxaline with phenanthraquinone. The aqueous solution obtained as above was acidified with acetic acid, and mixed hot with a solution of phenanthraquinone dissolved in aqueous sodium bisulphite with addition of sodium acetate. A crystalline precipitate of the sodium salt of diphenylene-β-naphthaquinoxalinesulphonic acid—



quickly separates. This sodium salt forms fine yellow needles, tolerably soluble in hot *pure* water to a yellow solution with a green fluorescence, but precipitated by the slightest trace of sodium hydrate or any salt. On heating it is decomposed, and diphenylenenaphthaquinoxaline sublimes. The free acid forms orange-red flocks, which become crystalline on boiling, and dissolve with a violet colour in strong sulphuric acid. Hence, Congo-red has the constitution—



On Fisetin, the Colouring Matter of Fustic-wood. Jakob Schmid. *Ber.* 19, 1734—1749.

ALTHOUGH the dyestuff of young fustic has been examined at various times by several investigators, very little light has as yet been thrown upon its constitution, the usual opinion being that it consists of quercetin contaminated with a red dyestuff. The author shows that this is not the case, for the wood contains a yellow dyestuff only—viz., *fisetin*, which is quite distinct from quercetin; the red colouring matter previously observed being formed by the oxidation of the *fisetin* in the process of isolation. The yellow colouring matter occurs in the wood as a tannic acid compound of the glucoside of *fisetin* (named by the author *fustin tannide*).

Fustin Tannide.—To obtain this body the wood is extracted with boiling water, the solution treated with lead acetate and acetic acid to precipitate impurities, the excess of lead removed by H_2S , the filtrate concentrated and saturated with salt, which precipitates the greater part of the tannic acid, and finally the *fustin tannide* extracted from the solution by acetic ether, from which it crystallises on evaporation. It forms long yellowish-white needles, easily soluble in water, alcohol and ether. With lead acetate and stannous chloride, it gives white precipitates, soluble in acetic acid. By warming with acetic acid it is resolved into *fisetin-glucoside* (*fustin*) and tannic acid (probably the tannic acid of sumac). By warming with alkalis or mineral acids, it is resolved into *fisetin*, a glucose, and tannic acid.

Fustin (Fisetin Glucoside), $(C_6H_{11}O_6)(C_{23}H_{12}O_5)_2 \cdot O$, $(C_{23}H_{12}O_5)(C_6H_{11}O_6)$.—This body crystallises from hot water in fine silvery needles, easily soluble in alcohol and dilute alkalis, sparingly in ether. It melts at $218-219^\circ$ with decomposition. With lead acetate and stannous chloride, it gives yellow precipitates soluble in acetic acid. Ferric chloride gives a beautiful green colouration, which, on adding dilute sodium carbonate, passes through bluish-violet into red. On heating, the glucoside reduces silver nitrate and Fehling's solution. By warming with dilute H_2SO_4 , it is split up into *fisetin* and a glucose (probably isodulcite).

Fisetin, $C_{23}H_{10}O_5(OH)_6$.—The dyestuff is most conveniently prepared in a pure state from the extract of the dyewood, which comes into commerce in a solid form under the name of "cotinin." The product is extracted with alcohol, and the impurities precipitated by careful addition of acetic acid and lead acetate; after removing the excess of lead by H_2S , the dyestuff is precipitated by the addition of hot water. By recrystallisation from dilute alcohol or acetic acid, it forms fine yellow needles, or yellow prisms ($+6H_2O$). It is very slightly soluble in hot water, easily soluble in alcohol and acetic ether, sparingly in ether and benzene. It melts at a high temperature, and sublimes in microscopic needles. With lead acetate and stannous chloride it gives orange precipitates soluble in acetic acid, with ferric chloride it gives a dark-green colouration. It reduces silver nitrate and Fehling's solution on heating. Fuming HNO_3 oxidises it to picric and oxalic acids. By fusion with KOH, or by reduction with sodium-amalgam in alkaline solution, it yields phloroglucinol and protocatechuic acid. On the other hand, by reduction with sodium-amalgam in acid solution, a red colouring matter is formed, which is readily reoxidised to *fisetin*, and gives a beautiful green colouration with KOH. The sodium and potassium salts of *fisetin* crystallise in yellow needles, and have the composition $C_{23}H_3O_5Na_2$ and $C_{23}H_4O_5K_2$. By heating *fisetin* with acetic anhydride and sodium acetate, it yields a hexacetyl-*fisetin*, $C_{23}H_4O_5(C_2H_5O_2)_6$, which crystallises from alcohol, in which it is sparingly soluble, in fine white needles, of melting-point $200-201^\circ$. The hexabenzoyl-*fisetin*, $C_{23}H_{10}O_5(OC_6H_5)_6$, forms white felted needles, sparingly soluble in alcohol, melting at $184-185^\circ$. By heating *fisetin* with ethyl iodide and alcoholic potash, the hexa-ethyl ether, $C_{23}H_{16}O_5(OC_2H_5)_6$, is formed, which crystallises in long yellow needles, of melting-point $106-107^\circ$, easily

soluble in alcohol, ether, etc. The hexamethyl ether, $C_{23}H_{16}O_5(OC_2H_5)_6$, forms yellow needles, melting at $152-153^\circ$.—A. G. G.

Preparation of o- and p-Nitraniline from the Corresponding Nitrophenols. V. Merz and C. Riz. *Ber.* 19, 1749—1754.

THE best method at present known for the preparation of *o*-nitraniline is that given by Nietzki and Benkiser (*Ber.* 18, 2296), which consists in sulphonating acetanilide, nitrating the acetylsulphanilic acid, and finally removing the SO_3H group by heating with HCl. As the last stage of this operation is somewhat troublesome if the substance is required in quantity, the following method of preparation will probably prove more convenient. The author finds that if *o*-nitrophenol is heated with aqueous ammonia under pressure, the OH group is replaced by NH_2 . Twelve parts of *o*-nitrophenol are heated with 20 parts of aqueous NH_3 (35%) for 16 hours at $160-170^\circ$; the product is crystallised from water. The yield of *o*-nitraniline is about 60 per cent. of the *o*-nitrophenol employed. On the large scale the operation could probably be carried out in an iron autoclave.

p-Nitraniline is also formed in the same way by heating *p*-nitrophenol with aqueous NH_3 at $190-200^\circ$; the yield being likewise about 60 per cent.—A. G. G.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

Improvements in obtaining and treating Fibres from the Barks of Plants of the Urtica Family and the like. G. W. H. Brogden and E. Casper, London. From E. Fremy and V. Urbain, Paris. Eng. Pat. 2817, February 26, 1886. 6d.

THIS invention relates to the treatment of rhea fibres for effecting the separation of their epidermis from their inner integument. Various methods of treatment with alkalis are described, also a method of treatment with oleate of soda instead of caustic soda. The object of these various processes is in each case the elimination of pectose, cutose and vasculose.—H. A. R.

VII.—ACIDS, ALKALIS, AND SALTS.

Solubility of Calcium Oxide, with some Remarks on Lime Water. A. Goldammer. *Pharm. Centralb.* 26 442—446, 455—457.

THE author has again confirmed the known fact that the solubility of lime decreases with rise of temperature, and that at the boiling point of water scarcely one-half of the amount of lime which water takes up at 0° is dissolved. He also confirms Lamy's statement that the longer the lime and water remain in contact, the less calcium oxide is dissolved. The slaking of the lime has a great influence on its solubility, and the strength of the solution varies according as more or less water has been used to slake the lime, especially at the beginning. A large number of experiments show that while calcium oxide possesses in a marked degree the property of forming supersaturated solutions, calcium hydroxide does not. Solutions supersaturated at a low temperature contain about 2.4 grms. per litre (about double the quantity in ordinary lime water). At temperatures above 12° Goldammer found an average of 1.8 grm. CaO per litre. It is difficult to give an exact ratio for the solubility of calcium oxide in water, but 1:800 expresses as nearly as possible the proportion for an average temperature. In order to obtain a strong and equal lime water it is necessary to thoroughly shake the mixture of lime and water at the beginning. The caustic lime used should be as free as possible from calcium carbonate. The author gives the following method for the preparation of lime-water:—1 part of calcium oxide prepared from marble is slaked with 0.5 part distilled water, and the powder obtained added to 100 parts

distilled water, and the mixture well shaken. The lime-water is clear and colourless, and 100cc. should require at least 4cc. normal acid for neutralisation.

—G. H. M.

Improvements in the Manufacture of Chlorine from By-products of the Ammonia Soda Process, or similar Chemicals obtained from other Sources. W. P. Thompson, Liverpool. From Solvay & Co., Brussels. Eng. Pat. 8724, July 20, 1885. 6d.

THIS invention is a supplement to previous patents granted to Solvay in 1880 (No. 838) and 1884 (No. 7258). The process patented is the decomposition of calcium chloride with silica and alumina in presence of air. In practice this operation is carried out in a cupola furnace, but the heating of the cupola being a difficult problem, the inventors propose the addition of a certain proportion of inert material to the matter to be decomposed, in order to absorb the heat of the issuing gases, and to impart this heat to the air necessary for the decomposition. Formerly it was intended to use the residue from this process for making cement. It is now proposed to mix the residue, which consists of calcium oxide, alumina and silica, with solid ammonium chloride, and heat the dry mixture to 350° C., when all the ammonia is liberated, the chlorine combining with calcium to calcium chloride, which is thus most intimately mixed with alumina and silica, and well adapted to produce chlorine under the influence of air and heat. The same silica and alumina may thus be used over and over again to decompose successively an indefinite quantity of ammonium chloride.—S. H.

A New or Improved Process for treating Galvanised Iron or Steel. H. Grimshaw, Manchester. Eng. Pat. 9993, August 24, 1885. 6d.

THIS invention relates to a process intended principally for treating waste galvanised sheet iron or steel, so as to separate metallic zinc from iron, and utilise the same. The waste galvanised iron is treated either with dilute sulphuric, hydrochloric or nitric acids, or with a boiling solution of zinc chloride or sulphate which dissolves the zinc, leaving the iron or steel undissolved.—S. H.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Improvements in Drying and Evaporating Apparatus for use in the Manufacture or Treatment of Cement and other Materials. C. Kingsford, Middlesex. Eng. Pat. 6813, June 4, 1885. 8d.

THE inventor refers to a former specification (12,379, September 13, 1884), describing an apparatus for drying, evaporating, or calcining various materials, by the waste heat from a coke oven or other furnace, with which the said apparatus can be combined or connected. His present invention provides for the more economical and advantageous utilisation of the waste heat of coke ovens, by combining therewith a steam boiler or generator, such as was described in a former specification of the inventor's (1078, March 6, 1882), together with means for drying, etc., somewhat similar to those particularised in Eng. Pat. 12,379, September 13, 1884. An important application of the improved apparatus is the drying of slurry in the manufacture of cement.—E. G. C.

Improvements in the Manufacture of Plaster, and in the Machinery and Apparatus used in connection therewith. R. Stone, London. Eng. Pat. 8096, July 3, 1885. 6d.

THE raw materials, such as chalk, limestone, etc., are first treated with sulphuric acid, then burned in furnaces or kilns at an intense heat, and lastly ground, direct from the furnaces or kilns, by machinery described in detail in the specification. When the plaster is required to set very hard "a proportion of alumina, such as that

derived from river mud, unmanufactured, as obtained direct from the river bank," is burned with the materials soaked in vitriol.—E. G. C.

Improvements in the Manufacture of Artificial Stone. W. P. Thompson, Liverpool and London. From G. Lilienthal, Victoria. Eng. Pat. 9780, August 18, 1885. 4d.

KEENE'S marble cement (alum-gypsum), slaked lime, and curdled milk, are intimately mixed together, with or without addition of colouring matter, and worked to a very stiff paste. The mass thus obtained is cut off while coming through the opening of the mixer, and pressed into moulds of a suitable size and shape. The blocks harden without artificial heat, and can be employed as mosaic pavement and model stones.—E. G. C.

Improvements in the Treatment of Sewage Water by the Lime Process for the Production of Cement. G. R. Redgrave, London. Eng. Pat. 6520, May 15, 1886. 4d.

THE specification describes improvements upon the various patents granted to Major-General Scott for a like purpose. Finely-divided, washed clay is added to the undefecated sewage, which is then allowed to settle in a tank in the usual way. The effluent from this tank is divided into two portions—one containing five-sixths of the whole; this portion is treated with caustic lime, 20 to 24 grains per gallon being used. The effluent from the settlement of this is mixed with the one-sixth portion remaining from the first treatment, which is treated only with from 6 to 9 grains per gallon. The final effluent is clear, and not so highly alkaline, as is usual in the ordinary lime treatment. The sludge from the first tank is dried and used as manure, that from the second and third calcined into cement in the usual way.

—C. C. H.

X.—METALLURGY, Etc.

Cupola with Steam Blast. Beekert. Stahl. u. Eisen, 1886, 6, 399.

THE cupola designed by F. A. Herbertz, Cologne, is said to be economical in fuel, at least for small and moderate-sized foundries. The throat of the cupola is closed by means of doors, beneath which is placed a double tube within the wall ascending obliquely, and into which steam is blown. The hearth hangs beneath the shaft by means of bolts, and an adjustable slit is thus formed, which completely surrounds the furnace through which air is admitted to the cupola, instead of by the usual tuyères. The whole of the carbon of the fuel is said to be converted into carbonic anhydride, resulting in decided economy in fuel. The iron melted is said to be less changed than in other cupolas, the loss being 2.4 to 2.6 per cent., as against 6 per cent. in other furnaces.

—J. T.

Iron Phosphide in Basic Bessemer Slag. E. Jensch. Chem. Zeit. 10, 820.

THE author combats the idea that a considerable proportion of phosphorus occurs in the slag as phosphide. His experiments lead to the results obtained by J. Klein (Chem. Zeit. 10, 721)—namely, that the amount of phosphide present is almost a vanishing quantity. Thus, in eight samples of slag, the average amount of phosphoric acid obtained by the action of the powerful oxidising agents, alkaline carbonates with potassium chlorate, nitro-hydrochloric acid, and nitric acid, was 18.83 per cent., whilst solution in hydrochloric acid gave 18.54 per cent., showing a difference of 0.29 per cent. of phosphoric acid, or 1.54 per cent. of the phosphoric acid which may be supposed to be derived from phosphide. The maximum given by the slags was 3.79 per cent. Since the phosphate dust is largely employed in agriculture it was sought to ascertain whether this small amount of phosphide is readily decomposed so as to

become available for the plants. Slags showing the greatest amounts of phosphide were extracted repeatedly with hydrochloric acid, and the residue thus obtained was mixed with (a) garden soil, and (b) sandy loam, in which oats were sown. The plants grew excellently. The only liquid supplied to them was a titrated solution of sodium nitrate. At the end of three months the phosphide was almost completely converted into ferrous phosphate.—J. T.

Improvements in the Process of and Means for Zincing or Coating Sheet Metal with Zinc. F. W. Kofler and E. Zwierzina, Vienna. Eng. Pat. 12,485, October 19, 1885. 8d.

IN the hot process of zinc coating, the same mechanism which effects the withdrawal of the plate from the metal bath, causes the application of rotating steel wire brushes to the surface of the plate, whereby the excess of zinc is removed, and a better and more serviceable sheet is obtained.—W. G. M.

A New or Improved Treatment of Blast Furnace or other Slags for subsequently obtaining Useful Products therefrom. G. Craig, Lugar, N.B. Eng. Pat. 6128, May 6, 1886. 4d.

SLAGS in the compact state in which they usually occur, are almost unaffected by acids. It is proposed to obtain porous slags by means of the following machinery:—The molten slag direct from the furnace is run into a horizontal iron pipe, which is partly submerged in a trough of water. Through the centre of the pipe works an archimedean screw which drives the slag towards the end of the trough, thus permitting the liquid slag always to fall into clear water. The slag may be removed from the trough by means of a Jacob's ladder. A certain proportion of the sulphur existing in the slag is evolved as sulphuretted hydrogen, and may be utilised in the usual way. The slag, without further preparation, may then be treated with acids, when it is quickly decomposed.—S. H.

Improvements in Metallic Alloys. P. A. Newton, London. From C. A. Paillard, Geneva. Eng. Pat. 6367, May 11, 1886. 6d.

IT is sought to substitute for the use of steel in the mechanism of chronometers and watches, that of a non-magnetic and inoxidisable, but hard and elastic metal of small expansibility. For this purpose a series of nine alloys is described, consisting essentially of palladium (65 to 72 per cent.), copper (25 to 14.5 per cent.), and silver (5 to 10 per cent.), with smaller and variable proportions of nickel, steel, gold, platinum, or rhodium (singly or together) which may be used for hair springs and compensation balances. A harder metal for rollers, escapement wheels, and the like, contains 45 per cent. palladium, 25 silver, 15 copper, with 5 gold, 5 nickel, 3 steel, and 2 platinum. These alloys may be hardened by slow cooling from a red heat. They are best made by fusing half the palladium with all the other constituents under borax and charcoal, then re-fusing with the remainder of the palladium, and pouring into ingot moulds of the shape dictated by subsequent requirements.—W. G. M.

Improvements in the Process for Coating the Surface of Iron or other Metals with Tin, Lead, or Zinc. A. Gutensohn, London. Eng. Pat. 6404, May 12, 1886. 4d.

AFTER pickling, and before plunging into the bath of coating metal, the plates are dipped in a fluxing solution of chloride of tin, borax and ammonium chloride, containing from two to five per cent. of glycerine and a very slight excess of free hydrochloric acid. By increasing the quantity of acid, the necessity for the preliminary stage of "white pickling" is obviated.—W. G. M.

XL.—FATS OILS, AND SOAP MANUFACTURE.

Action of Sulphuric Acid on Oleic Acid. A. Szabanczew. Russ. Phys. chem. Ges. 18, 35 and 57.

PURE oleic acid cooled to 6° was treated with sulphuric acid (sp. gr. 1.8405) in the proportion of their molecular weights. The reddish-brown substance thus obtained was dissolved in ether and the solution agitated with water. The portion soluble in water was found to consist of *sulphohydroxystearic acid*, $C_{17}H_{33}O_2H(SO_3H)(CO_2H)$. The insoluble portion was again treated with ether and thereby separated into a solid and liquid part. The solid was *hydroxystearic acid*, whilst the liquid product consisted of a mixture of *hydroxystearic anhydride*, *hydroxystearic acid* and unaltered oleic acid. The author is of opinion that the action of sulphuric acid on oleic acid cannot be expressed in one equation, as illustrated by Müller-Jacobs, Liechti and Suida and Lukjanow, but supposes that several reactions occur simultaneously.—D. B.

Improvements in Liquid Soap. R. Livesey. From Dr. Duncan, St. Petersburg. Eng. Pat. 12,305, October 15, 1885. 4d.

THE soap is made from 50 parts cocoa oil or oleine, 20 alcohol, 20 glycerine, and 10 potash (K. H. D. F. in F.), and the ingredients required for scenting and colouring, or for sanitary and medical purposes, are then introduced. No further details are given.—W. L. C.

Extracting Oils from certain Waste Products. A. T. Hall. Eng. Pat. 12,492, October 19, 1885. 6d.

IN "tinning" iron plates, baths of hot grease or oil are employed in the finishing operation, and bran is employed to remove the grease adhering to the plates. Under this patent, the oily bran is treated with a solvent, such as light petroleum oil, by well-known methods, for the recovery of the grease and the cleansing of the bran.—W. L. C.

Improvements in Refining Vegetable Oils. A. T. Hall. Eng. Pat. 13,361, November 4, 1885. 4d.

CRUDE OIL is mixed with an equal quantity of petroleum spirit or of carbon disulphide, and to the mixture is added in thread-like streams, from $\frac{1}{2}$ to 5 per cent. of sulphuric acid. After agitation and subsidence, the oil solution is filtered through animal charcoal, and the solvent is then recovered by distillation.—W. L. C.

XIII.—TANNING, LEATHER, GLUE, AND SIZE.

A New or Improved Method of Preparing Elastic Leather and Elastic Material (suitable for Moulding) from Animal Textures or Leather containing Gelatin. Lorentz Albert Groth, London. From Friederich Wilhelm Grüne, Berlin. Eng. Pat. 9603, August 12, 1885. 4d.

ANIMAL textures containing gelatin, such as leather, parchment, etc., are steeped in an aqueous solution of glycerine or sugar and then dried. The material is then exposed to steam at a low pressure or direct heat. There is thus produced a thick, elastic mass which may be moulded by suitable means, etc.—B. H.

Improved Compound for application to Wood, Metal, or other Substance as a Paint or Varnish to prevent Decay, Rust, or other Injury by Atmospheric Action. Henry Gardner, London. From David Lublinski, Schwet, Germany. Eng. Pat. 10,409, September 2, 1885. 6d.

THE compound is made by melting together 25,000 parts linseed oil, 31,250 colophony, 18,250 doubly-rectified American petroleum, 1,250 levigated litharge, 500 pulverised zinc sulphate, 1000 pulverised potash-alum, and 250 parts carbolic acid of 15–20 per cent. The mixture is then boiled for two hours, and allowed to stand for two days.

The clear fluid, called by the inventor "ceralin," can be used without other addition for the impregnation of wood, etc. Mixed with colour it forms a preservative paint for iron.—B. II.

XV.—SUGAR, GUMS, STARCHES, Etc.

Preparation of Calcium Saccharate. Sueretic Indigène, 27, 488.

THE lime used as precipitant in Steffen's defecation process may be substituted by ammonia, the trisaccharate being insoluble in highly-ammoniacal solutions. The ammonia employed is recovered from the liquors.—D. B.

Percentage of Juice in the Sugar Cane. Spencer. Jour. Fabr. Sucre, 27, 15.

ACCORDING to Delteil, the sugar cane contains 85–92 per cent. of juice, whilst Pellet obtained from 88–90 per cent. and MacCulloch 85 per cent. The author gives 90.5 per cent. as the average number of a series of trials. Beet contains from 94 to 95 per cent. of juice.—D. B.

Improvements in the Manufacture of Crystallised Grape-sugar. Alfred Seyberlich, Riga; and Alexander Trampedach, Mitau, Russia. Eng. Pat. 8000, July 1, 1885. 6d.

CONSISTS of a process for the manufacture of crystallised grape-sugar in which the employment of alcohol, bone-charcoal, or permanganate of potash for the purification and cleaning of the liquid grape-sugar is rendered unnecessary.

The saccharification of the starch is accomplished by the exclusive or predominant use of dilute nitric acid, and the sugar liquor prior to inspissation in a vacuum is made strongly alkaline by means of carbonate of soda. It is found that on evaporation of the strongly alkaline syrup to about 33° to 36° Baumé, and on then leaving to cool, the grape-sugar separates out in fine bold crystals, which can be easily separated from the mother-liquor. On the other hand, if the acid syrup be merely neutralised and not made strongly alkaline, the grape-sugar only separates with difficulty and in the form of fine needles, which cannot easily be freed from the mother-liquor.

—A. J. K.

A Honey Substitute. Charles Lyle and J. J. Eastick, London. Eng. Pat. 8863, July 22, 1885. 4d.

THIS article is produced by mixing dextrose, levulose, and cane-sugar in the proportions found in real honey, with in some cases the addition of other matters, such as fruit and flower essences, to give it the flavour of real honey.

It is usual to add 35 parts dextrose to 40 parts of levulose, and then to this mixture add cane-sugar until a 10 per cent. solution of the whole mixture reads 1° on the scale of a Soleil-Weutze polariscope.—A. J. K.

The Improved Utilisation of Sugar Cane. A. G. Wass, Bermondsey. Eng. Pat. 9249, August 1, 1885. 6d.

THIS consists of a process by which the cane or residue of sugar boiling is dried, pressed, and then heated for some time in order to cause carbonisation. The carbonised material can then be used for the body of paint or ink, as a disinfectant and as a fertiliser, or it is suitable for filtering purposes.—G. H. M.

An Improved Process of Manufacturing Sugar from Amylaceous and Cellulose Matters. A. C. Henderson, London. Eng. Pat. 10,110, August 26, 1885. 4d.

NO acid is used in this process. Twenty-five per cent. of the amylaceous or cellulose matter (preferably potatoes) are mixed with 75 per cent. of water and boiled in a digester at a pressure of four atmospheres and temperature of 125° C. The boiled mass is afterwards removed, cooled down to 45° C., and 10 per cent. of brown

kiln-dried malt is then added. The whole is well stirred and allowed to rest about two hours. The syrup is finally evaporated down in a vacuum pan at 70° C. and allowed to crystallise.—A. J. K.

Improvements relating to the Refining of Sugar, and to Apparatus therefor. H. H. Lake, London. Eng. Pat. 3727, March 16, 1886. 11d.

THE object of this invention is the saving of labour in connection with the manufacture of loaf sugar in moulds. By an elaborate arrangement of trucks and rails extending over the whole works, the sugar, after it is once filled into the moulds arranged on one of the trucks or carriages, is not removed again from that carriage until all the refining operations have been completed. Full description with diagrams of the necessary plant is given.

—A. J. K.

Improvements in Apparatus for the Manufacture of Refined Sugar. Peter Jensen. From M. C. P. Barbe, Amsterdam. Eng. Pat. 4516, March 31, 1886. 6d.

THIS relates to an improvement in the construction of the partition wedges and centrifugal drum described in a previous patent (Eng. Pat. 10,172, August 27, 1885). According to the present invention, these wedges are simplified in construction, and so modified as to serve also for lifting out the slabs of sugar from the centrifugal hydro-extractor.—A. J. K.

XVI.—BREWING, WINES, SPIRITS, Etc.

New Process for Preserving and Saving Hops in Brewing. L. Boulé. Compt. Rend. 102, 833.

THE process consists in (1) mechanically separating the lupulin situated at the base of the hop cones, (2) extracting the hops freed from lupulin with boiling distilled water, and drying the extract at a low temperature in a vacuum, and (3) intimately mixing the lupulin with the dried powdered extract.—D. B.

Improvements in the Manufacture of Syrup and Beer from Maize, or Indian Corn and Rice. H. H. Lake. From A. E. Feroe, Poughkeepsie, U.S.A. Eng. Pat. 9950, August 21, 1885. 5d.

THIS is to provide an economical method of separating the insoluble matter in a malt and maize mash from the soluble portions. The chief features are the method in which the starch of the maize is prepared for conversion, thus requiring only a small quantity of malt; the presence of a comparatively small quantity of fine insoluble matter owing to the use of granulated maize with granulated malt instead of ground meal and malt; and an easier way of separating the fine insoluble matter after conversion by means of gelatine and a gas. Detailed description of the method employed, together with illustrations of the plant employed, are given.—G. H. M.

Improvements in treating Wines and Liquors with Electricity, and an Apparatus for the purpose of carrying out the same. E. J. Fraser, San Francisco, U.S.A. Eng. Pat. 11,153, September 19, 1885. 5d.

THIS consists of improvements in the application of electricity to alcoholic liquids for the purpose of "ageing" them. This is done by the "induction process," placing a coil or helix, formed like the helix of an electro-magnet, in the wine or other liquid, and connecting the coil with a battery. Full descriptions of apparatus employed are given.—G. H. M.

Improvements in the Production of Non-alcoholic and Unfermented Wines, Drinks, and the like. H. N. Eckel, London. Eng. Pat. 16, January 1, 1886. 6d.

THE preparation of wines and drinks from fresh grape juice, or from the juice of other fruits of an unferment-

able character and entirely free from alcohol, is apparently effected by sterilisation of the must, subsequent addition of antiseptics, and aëration with carbonic acid under pressure.—G. H. M.

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

(A) CHEMISTRY OF FOODS.

Pepsin. C. Sundberg. *Zeits. f. Physiol. Chem.* 9, 319–322.

THE author prepared in Hammarsten's laboratory the purest possible pepsin-solution. The outer layer of the coating of a calf's stomach was cut into shreds, finely ground with sodium chloride and then mixed with sufficient water to dissolve the salt; after two or three days it was filtered, and the sodium chloride removed by dialysis in acidified water; the protein bodies separated in the dialyser were filtered off, and the solution heated for some time to 40° in order to destroy the rennet ferment, and also to peptonise the still unchanged albuminoids. (It often requires one to two weeks before the solution gives no reaction with acetic acid and potassium ferrocyanide, and until no ring is formed after 8–9 minutes with Hellet's test.) The still acid liquid was now mixed with calcium chloride and sodium diphosphate solutions neutralised with dilute ammonia; this treatment repeated two or three times, the calcium phosphate solution containing pepsin collected on a filter, washed, and dissolved in a little 5 per cent. hydrochloric acid. When this solution is purified by dialysis, a very active pepsin solution is obtained; and since it gives no reactions for albumen—it differs in this respect from Briicke's pepsin solution, which reacts with platinum chloride, neutral and basic lead acetate, and is only precipitated by alcohol—Sundberg concludes that pepsin does not belong to the albuminoids.—G. H. M.

(B) SANITARY CHEMISTRY.

A New or Improved Treatment of Chemical Agents, and the Employment of the Resultant for the Precipitation, Clarification, and Defecation of Sewage Matters. G. W. Bremner, London. Eng. Pat. 13,761, November 11, 1885. 6d.

NATURAL phosphate of alumina—e.g., Redonda and Alta Vela phosphates—is calcined in a reverberatory furnace with sodium, potassium, or calcium salts. The resultant is then treated with water, with or without the addition of caustic soda or potash, at a temperature of 180° F. An acid extract may be similarly obtained by the use of mineral acids. The two solutions so obtained are added to the sewage in such proportions that “the products held in solution are liberated” and “the sewage matter is oxygenised.” The resultant sludge is filter-pressed, dried, ground and mixed with bone refuse. The claims are (1) the preparation of the extracts of phosphate of alumina as above described; (2) their use in the treatment of sewage.—C. C. H.

(C) DISINFECTANTS.

Improvements in the Manufacture of Carbon-alum, and Application of the same to Useful Purposes. T. H. Cobley, Dunstable. Eng. Pat. 9853, August 19, 1885. 6d.

CARBON-ALUM is an intimate combination of alumina with carbon, and is to be applied for treating sewage matter or such like purposes. Equal parts of coke-dust and clay are ground with water to a stiff paste, and then heated in a retort furnace or other contrivance, where the air can be excluded. The mass is then treated with one-third of its weight of sulphuric acid, 120° Tw., and allowed to digest by spreading it on a tile hearth heated at a low temperature. In order to use carbon-alum, thus prepared, for rendering innocuous, sewage matter or polluted water, the deodorising agent is exposed in

troughs or beds provided with perforations through which the sewage matter is made to pass. Or it may be ground up into a thin liquid state with water, and run into the polluted water kept in brisk agitation.—S. H.

The Manufacture of an Improved Antiseptic. H. H. Lake, London. From C. Collins & Co., Antwerp. Eng. Pat. 10,130, August 26, 1885. 4d.

THE patentee claims the production of an antiseptic having all the reactions and characteristics of salicylic acid by heating two volumes of phenic acid with one volume of Nordhausen acid. The substance produced is a mixture of ortho-, meta-, and para-oxyphenyl-sulphurous acid.—C. C. H.

Improvements in preventing and removing Incrustation in Boilers and Heaters. A. Roberts, Tipton. Eng. Pat. 10,423, September 3, 1885. 6d.

VEGETABLE MATTERS, such as hay ensilage, tan, oak bark, or Irish moss, are suspended in a cage in the interior of the boiler, the infusion of which accomplishes the object aimed at; or the infusion may be made in a separate small boiler and injected into the main boiler.—C. C. H.

XVIII.—ELECTRO-CHEMISTRY.

Improvements in the Manufacture of Carbon for Electric Lamps and other Electrical Apparatus. From La Société à Chertemps et Cie., Paris. Eng. Pat. 7222, June 13, 1885. 4d.

IN this invention, fluoride of boron and its derivatives are employed for dehydrating organic matter containing the elements of water in chemical combination, with the object of obtaining carbon suitable for use in the construction of lamps. After treating the organic matter with fluoride, it is subjected to an elevated temperature without access of air or oxygen, to remove excess of fluoride. The carbon is now impregnated with some carbo-hydrate, as sugar, glucose, etc., and the operations of exposure to fluoride, and submission to elevated temperature are repeated until the desired degree of density and conducting capacity in the carbon are attained.—B. T.

Improvements in Secondary Batteries, part of which is applicable to Primary Batteries. From Edmund Julien, Brussels. Eng. Pat. 8881, June 23, 1885. 8d.

THE scope of this invention is indicated by the claims:—The combination of parts forming an improved accumulator or secondary battery, the plates being composed of an alloy of lead, antimony, and quicksilver supporting the active materials of metallic salts contained in a bath, hold a suitable proportion of peroxide of hydrogen. The production of the alloy in the proportions indicated. In secondary batteries, the use of plates composed as above and coated with active material. The use in the conducting liquid of a variable proportion of peroxide of hydrogen for the purpose of counteracting the polarisation. In secondary batteries the use of corrugated plates and the use of perforated plates designed to replace sharp angles opposite each other by plane or curved surfaces. The improved mode of joining plates together by means of flexible conductors covered with gutta-percha, and joined at a common terminus.—E. T.

An Improved Process and Apparatus for treating Metals, Alloys, and especially Auriferous Ores by Electrolysis. Henry R. Cassel, London. Eng. Pat. 8574, July 15, 1885. 8d.

THIS patent is based on the action of nascent chlorine on gold and certain other metals, and its generation by the electrolysis of common salt. Gold is deposited at the cathode (see 4879, October, 1883). The apparatus consists of a drum containing carbons forming the positive pole, mounted upon a hollow shaft, the ends of

which pass into tanks forming the cathode, the drum revolving, and the portion of the shaft within the drum perforated, and its outer surface insulated and covered with asbestos. The hollow shaft has an archimedean screw for causing the solution to circulate, and for the removal of the slimes. The shaft passes through stuffing boxes into standards, which serve as tanks. The revolving apparatus contains carbons connected by metallic rods, and these are connected with one pole of the source of electricity by means of brushes or rollers, while the shaft on which the drum is mounted is connected with the other pole. There are twelve claims in the patent.—B. T.

Improvements in Galvanic Batteries. William Hy. Quarterman, London. Eng. Pat. 8733, July 20, 1885. 8d.

THE object of the invention is to simplify the charging and discharging of galvanic batteries so as to be readily used for domestic electric lighting. The construction is simply that of a series of glazed cells, each with an opening in the bottom capable of being stopped at will, and containing the carbon electrodes, which are hollow and closed at the top, the end projecting so as to be fitted to a cap or hollow cork. The zinc electrodes are tubular, and are made to fit tightly into the covers of the jars. The series of cells is contained in an outer vessel fitted with taps so that the liquids can be drawn off conveniently.—B. T.

Improvements in Electric Batteries. From A. W. Desruelles, Paris. Eng. Pat. 9415, August 7, 1885. 8d.

THIS invention relates to a battery, the exciting liquid in which is composed of sulphuric acid macerated with peroxide of manganese and mixed with mercury bisulphate, oil, glycerine and water. Also a depolarising liquid which has in addition to sulphuric acid and manganese peroxide, any alkaline bichromate and nitric acid and water. The carbon plates, or electrodes, are treated with a solution of sugar, which is subsequently carbonised; these plates are grooved so as to increase the depolarising surface. There are patented arrangements for hermetically closing the external and porous vessels of the battery, and contrivances for ensuring steadiness in the plates and securing them from injury by the action of the liquids. Also arrangements for protecting the suspending rods.—E. T.

Improvements in Electrical Accumulators or Storage Batteries. C. P. Elieson. Eng. Pat. 9522, August 10, 1885. 8d.

THE inventor employs spirals or cylinders of sheet lead separated superficially by insulating and acid-proof material. The cylinders are placed in frames of lead or other suitable material. The advantages claimed are—that no oxides of lead are required; that the spiral or cylinder affords a very large acting surface for electrical storage; that the cells so constructed increase in capacity so long as disintegration of the frames is avoided.—E. T.

Improvements in the Preparation and Production of Insulating Compounds for Electrical Purposes. Alexander Muirhead and C. R. A. Wright, London. Eng. Pat. 9580, August 12, 1885. 6d.

THIS patent is an extension of Eng. Pat. 5835 of 1883 and 8077 of 1884, and its object is to produce elastic materials from suitable oils more perfectly, and to purify such elastic materials, especially from unaltered oily matters which depreciate the insulating power, or facilitate decay. The use of chloride of sulphur is entirely obviated, and the polymerisation, which is often accompanied by partial dehydration, is effected by metallic salts having powerful affinity for water, such as zinc bromide and chloride or anhydrous copper sulphate. Castor oil is specifically referred to by the patentees, who classify their claims under four heads.—B. T.

An Improved Galvanic Element or Battery. From Karl Pollak and G. Wehr, Berlin, Germany. Eng. Pat. 9896, August 20, 1885. 8d.

THIS invention relates to a galvanic element in which the depolarising substances are always regenerated. Zinc and "metal" elements—i.e., Zn and Cu—are used by setting the "metal;" that is to say, in the case of a zinc-copper element, the copper in conducting connection with the carbon, which only dips partly in the exciting liquid, which will be different according to the nature of the element. The construction of the elements is by suspending a cylindrical glass vessel in a clay vessel provided with many openings. The clay cell is filled with small pieces of metallic lead or silver, mixed with pieces of carbon, and a suitable carbon plate dipping into this carbon and lead mixture serves to conduct the current to the terminal. Through the middle of the clay passes an insulated copper wire to the zinc plate placed below the perforated clay cell. The cylinder is so far filled with, for instance, a solution of common salt, that the clay cells dip but a little into the liquid. It is needed that the metal situated in the clay cell should be oxidisable. Drawings accompany the patent.—B. T.

Improvements in Compound Galvanic Batteries, and in the Method of working the same. S. H. Emmens, London. Eng. Pat. 10,011, August 24, 1885. 4d.

THE inventor proposes to simplify the construction of compound galvanic batteries, and to diminish the cost of charging the secondary elements. First, by employing as electrodes in each cell one or more peroxidised lead plates, which are so mounted as to be easily replaced. The electrolyte is dilute sulphuric acid by preference. The oxidation of the exhausted plates is effected by using them as anodes in a bath capable of yielding oxygen from the solution when electrolysed. The inventor uses copper sulphate as an electrolyte in the bath, because he can charge the lead plates by means of a current of lower electromotive force than that evolved by their discharge in the battery.—E. T.

Improvements in Galvanic Batteries. Leon Napoleon Loeb, London. From abroad. Eng. Pat. 2647, Feb. 23, 1886. 8d.

THE invention consists in the production of a new depolarising fluid, and of a ring or clamping device to hold in position the carbon plates or negative element of the battery, thus enabling the carbon plates to be placed close to the porous cell, and so decrease the internal resistance caused by the electric current having to pass through so large an amount of fluid. The depolarising fluid consists of 4lb. soda bichromate, 12 parts sulphuric acid, and water 6 parts by weight. The surface of the carbon is coated with paraffin, stearine, or wax.—E. T.

Improvements in Galvanic Batteries. Leon Napoleon Loeb, London. Communication from abroad. Eng. Pat. 2648, February 23, 1886. 8d.

THIS invention relates to improvements in the construction of galvanic batteries, specially for incandescent electric lighting. Essentially the construction is an outer box of wood or other non-breakable substance, lined internally with a close-fitting box or cylinder of paraffin, stearin or wax, and a cylinder of zinc, which rests in a groove or cup within the usual porous cylinder. The grooves retain sufficient mercury to keep the zinc amalgamated. The porous cup is properly supplied with sulphuric acid (1 to 5 of water). The outer jar is partially filled with a depolarising solution, consisting of salt, soda bichromate, sulphuric acid and water. The depolarisation is claimed as due to the production of free chlorine. There are seven claims in the patent.—B. T.

Improvements relating to the Conversion of Heat-energy into Electrical Energy, and to Apparatus therefor. From Willard E. Case, New York, U.S.A. Eng. Pat. 4937, April 8, 1886. 8d.

THE invention is based upon the decomposition by heat of chromium chloride, in the presence of tin, into free chlorine and chromium protochloride. The chlorine then combines with powdered metallic tin—to form tin protochloride—and as a consequence of this reaction an electrical current is established through the liquid and between the metallic tin as one electrode, and the carbon plate as the other electrode. The heat is maintained until all the tin is converted into protochloride: the apparatus—which is merely an open tank containing water—in which the decomposing vessel is placed, is now exhausted. The source of heat is removed and artificial cooling resorted to, when the original compound is re-formed, and by the time the normal temperature is reached, the original conditions are resumed, and the operation and the reactions commence on heating as at first. There are twelve claims in the patent.—B. T.

XIX.—PAPER, PASTEBOARD, Etc.

An Improved Method of making Paper Transparent to render it suitable as a Substitute for Glass for Photographic and other Purposes. W. B. Woodbury and F. Vergara, London. Eng. Pat. 9575, August 11, 1885. 6d.

THE paper prepared by this process is to be used in place of glass in photography, one advantage being the reduction in the weight of the plates. Thin and even-textured paper is to be treated in the following baths:—Benzene, 32 ounces; gum dammar, 61 ounces; mix well for 24 hours till gum entirely dissolved. Benzene, 2 ounces; gum elemi, $\frac{1}{2}$ ounce; mix as above. The two solutions are mixed and filtered thoroughly through fine muslin. The paper is to be treated in separate sheets, and dried at about 80° F. The second bath consists of the following:—Gelatine, 2 ounces; water, 40 ounces, after which the paper is allowed to dry. Sheets of paper rendered transparent in this way can be used for coating with emulsion, or for other purposes, such as making tracings or drawings. When used as a substitute for glass for photo-negatives, paper so treated is very light, and has many other advantages over glass for this and many other purposes.—H. A. R.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

On a Constituent of the Root of Paeonia Moutan. W. Will. Ber. 19, 1776—1777.

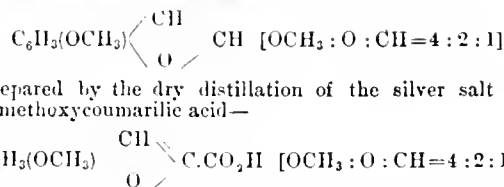
By distilling the dried root of the Japanese peony (*paeonia moutan*) by means of a current of steam, three or four per cent. of *peonol* passes over. This body, which was discovered by Nagai, has the constitution—



and is thus a mono-methyl ether of dioxyacetophenone. It forms fine colourless needles, of melting point 47°. By fusion with KOH it yields β -resorcylic acid. By demethylation it gives a dioxyacetophenone identical with that obtained from resorcinol.—A. G. G.

On Umbelliferone. W. Will and P. Beck. Ber. 19, 1777—1786.

It has already been shown that two isomerides exist of the dimethylumbelliferic acid, of which the less stable α -isomeride melts at a lower temperature than the stable β -isomeride. A considerable number of derivatives is described possessing no special industrial interest, with the exception, perhaps, of the *p*-methoxycoumarone—



prepared by the dry distillation of the silver salt of *p*-methoxycoumarilic acid—

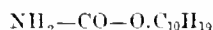
It is a colourless oil, somewhat heavier than water, and having a powerful odour of flowers. It boils at 178—180°, is very volatile with steam and easily soluble in alcohol and ether.—A. G. G.

Some New Constituents of Atropa Belladonna. H. Kunz. Arch. Pharm. [3], 23, 721—735.

IN addition to the true belladonna and hyoscyamus alkaloids, there occurs also both in the belladonna and hyoscyamus a substance soluble in water, bile-neurine or choline, $C_5H_{15}NO_2$. The quantity of the former amounts in extractum belladonnae to about 1.8 per cent., in extractum hyoscyami to about 0.5 per cent.; of the latter, in belladonna extract, to about 1 per cent., in hyoscyamus extract, to 3 per cent. The fluorescence of an alkaline solution of extractum belladonnae is due to elrysatropic acid, $C_{12}H_{10}O_5$, which occurs in all parts of the plant, together with a smaller quantity of leucotropic acid, $C_{17}H_{22}O_5$. In the extract prepared from belladonna plant, normal succinic acid occurs to the extent of 0.6 per cent.—G. H. M.

On some Menthol Derivatives. G. Arth. Ann. Chem. Phys. 7, 433.

BY the oxidation of menthol with potassium permanganate a mono-basic acid named *hydroxymenthyllic* acid, $C_{10}H_{18}O_5$, is obtained. It forms a viscid liquid, boiling and decomposing at 280°. Distilled under a pressure of 15mm. it boils at 173—175° without decomposition. It is sparingly soluble in water, but dissolves freely in alcohol and ether, and forms very hygroscopic white crystalline salts with alkalis. In addition to this acid the following oxidation products are formed:— β -pimelic acid $C_7H_{12}O_4$, butyric, propionic, formic, oxalic and carbonic acids. When cyanogen and cyanogen chloride act on menthol, *mentholurethane*—



and *menthylcarbonate*, $CO(C_{10}H_{19}O)_2$, are obtained. The former melts at 165°, and is decomposed when heated with water or dilute hydrochloric acid, carbonic anhydride, ammonia and menthol being produced. Menthyl carbonate melts at 105°. To corroborate the alcoholic character of menthol, a series of solid crystallisable ethers was prepared and examined: *Menthylbenzoate*, $C_{11}H_{15}.COOC_6H_5$; *normal and basic menthylsuccinate*, $C_6H_4(COOC_{10}H_{19})_2$, and $COOH-C_2H_4-CO.OC_{10}H_{19}$; and *normal and basic menthylphthalate*, $C_6H_4(COOC_{10}H_{19})_2$; and $COOH-C_6H_4.COOC_{10}H_{19}$.—D. B.

Processes for the Preparation of m-Methoxy-p-nitrobenzaldehyde for use in the Manufacture of Vanillin. Ludwig Landsberg, Offenbach-on-the-Main, Germany. Eng. Pat. 6190, May 7, 1886.

THE inventor claims the preparation of *m*-chloro-*p*-nitrobenzaldehyde by the conversion of *m*-chloro-*p*-nitrotoluene into *m*-chloro-*p*-nitrobenzyl chloride, or into *m*-chloro-*p*-nitrobenzyl bromide, and boiling these products with a solution of nitrate of lead or of copper, substantially as described. Also the preparation of *m*-methoxy-*p*-nitrobenzaldehyde by heating *m*-chloro-*p*-nitrobenzaldehyde with alkali methylate or alkali hydroxides dissolved in methyl alcohol, or by the conversion of *m*-chloro-*p*-nitrobenzaldehyde by heating with an aqueous solution of caustic or carbonated alkalis, into *m*-oxy-*p*-nitrobenzaldehyde, which is finally converted into *m*-oxy-*p*-nitrobenzaldehyde by treatment with methyl.—T.

XXI.—EXPLOSIVES, MATCHES, Etc.

Improvements in the Manufacture of Gunpowder and analogous Explosives. F. B. W. Roberts. From Friedrich Becker, Amtenhaus, Germany. Eng. Pat. 368, January 10, 1885. 2d.

THE object of this invention is to obtain a gunpowder giving increase of velocity and decrease of pressure in the gun. This object is sought to be obtained by employing in place of the ordinary charcoal, the product obtained by charring wood, by preference dogwood, to a yellow or chocolate colour. The proportions of the constituents preferably employed are 80 parts of potassium nitrate, 3 parts of sulphur, and 17 parts of the charred dogwood. What is claimed is, first, in the manufacture of gunpowder or similar explosives, the use of under- or but partially-charred dogwood or other woody matter; second, the manufacture of gunpowder or similar explosives by the combination of saltpetre, sulphur, and under- or but partially-charred dogwood or other woody matter, in the proportions previously mentioned, or thereabouts.

—W. D. B.

An Improved Explosive Compound. H. H. Lake. From Charles Lamm, Stockholm. Eng. Pat. 13,690, November 10, 1885. 6d.

ACCORDING to this invention, an explosive mixture termed "Bellit" is prepared by mixing a nitrate with a nitro-compound, "containing carburetted hydrogen," such as dinitro-benzene, trinitro-naphthalene, or nitro-toluene, and then subjecting the mixture to a temperature of from 50° to 100° C., the object being to effect the fusion of the nitro-compound, and thus coat the particles of the nitrate to protect the same against atmospheric influences. As examples of the proportions employed, the following are given:—1 part of dinitro-benzene with at least 0.96 part of potassium nitrate; 1 part of trinitro-naphthalene with at least 1.41 parts of potassium nitrate, it being calculated that with these proportions the carbon will be oxidised to the monoxide. If deemed advisable, the proportion of nitrate may be increased in order to effect the complete oxidation of the carbon.—W. D. B.

Improvements in Explosive Compounds. C. E. Bichel, Berlin. Eng. Pat. 15,528, December 17, 1885. 4d.

A MIXTURE of 10 parts of a hydrocarbon, with 3 parts of sulphur, is distilled at a temperature of from 90° to 150° C. The distillate, consisting of a muddy liquid, is clarified by washing, and is then mixed with potassium nitrate, in the proportion of 100 parts of the distillate to 30 parts of the nitrate. The "explosive oil" thus produced may be mixed with an absorbent, and formed into cartridges. The "explosive oil" may also be obtained by mixing potassium nitrate with carbon disulphide in the cold, and then adding the liquid hydrocarbon. "The product must be carefully washed."—W. D. B.

XXII.—GENERAL ANALYTICAL CHEMISTRY.

Alpha- or Beta-Naphthol in the Presence of Sulphuric Acid a Test for Nitric and Nitrous Acids, and Free Chlorine. H. Hager. Pharm. Centr. 26. 353—354.

A ONE PER CENT. solution of naphthol in absolute alcohol is used. 3—4cc. of the liquid to be tested is mixed with 2cc. of naphthol solution, and then 15—2cc. pure concentrated sulphuric acid allowed to run down the side of the vessel with great care, and collect at the bottom. According to the quantity of acid or chlorine present the layer of the liquid in contact with the sulphuric acid in a few seconds becomes yellow, brownish-red or brownish-black.—G. H. M.

Valuation of Calcium Acetate. H. Phillips. Chem. News, 53, 181.

1GRAM. of the sample is distilled in a 100cc. retort, with 10cc. of a 40 per cent. solution of phosphoric acid, and

40cc. of water, until the retort contains only about 5cc. of liquid. The residue is allowed to cool, treated with 50cc. of boiling water, and distilled as before. After repeating this operation the whole of the acetic acid will have been carried over. The distillate is then titrated with a standard solution of soda, phenolphthalein being used as indicator. To economise time the author proposes to place the retort with the stem pointing upwards in an inclined direction. The stem is covered with flannel, and has the end curved so as to pass easily into the condenser. The retort is closed by a caoutchouc stopper fitted with a small funnel, through which the water enters. During the distillation the funnel is closed by means of a small-tapered glass rod, covered with indiarubber tubing.

The valuation of calcium acetate is frequently effected by converting the calcium salt into sodium acetate by treatment with sodium sulphate, decomposing the acetate into sodium carbonate by ignition, and titrating the alkali thus produced. The author finds this process to be very liable to error, and consequently does not recommend its adoption.—D. B.

Estimation of Glycerol in Wine and Beer. J. Skalweit. Rep. Anal. Chem. 6, 183.

100cc. of wine or 200cc. of beer are mixed with 10grms. of quartz sand (20grms. in the case of beer), and 3cc. of milk of lime (200grms. calcium hydroxide in 500cc. of water), and evaporated nearly to dryness. The mixture is then boiled out with about 150cc. of alcohol (90 per cent.), and the residue extracted with alcohol (90 per cent.), in Soxhlet's extraction apparatus. After concentrating the mixed extracts to a syrupy consistence, the mass is treated with 10cc. of pure alcohol and 15cc. of ether. The clear solution is distilled in a flask provided with a long neck, 30—40cc. of water being previously added to the liquid. The distillation may be carried on without loss of glycerol until the fluid in the flask has been reduced to from 5—10cc. The residual liquid is then weighed and the glycerol determined with Abbe's refractometer, the results being calculated according to the glycerol table given in *Rep. Anal. Chem.* 5, 18, and *Chem. Zeit.* 9, 433.—D. B.

Estimation of Mineral Oils in Fats. Finkener. Mitth. Techn. Versuchs-Anstalten zu Berlin, 4, 13.

OILS containing less than 10 per cent. of unsaponifiable fat are treated as follows:—10grms. of oil are heated for 15 minutes on a water-bath with 50cc. of an alcoholic solution of soda (35grms. NaHO dissolved in 85cc. of water and 730grms. of boiling alcohol), 5grms. of sodium carbonate are then added, and the solution is heated until the alcoholic odour has disappeared. The liquid is then transferred to a glass cylinder, agitated with 300cc. of light petroleum boiling under 100° and filtered. 150cc. of the petroleum extract (equal to 5grms. of oil) are then distilled to a small bulk. The residue is transferred to a watch-glass, dried and weighed. Commercial fatty oils yield from 0.5 to 3 per cent. of unsaponifiable residue. In the case of oils containing more than 10 per cent. of mineral oils, the estimation may be effected by determining the quantity of alkali required to saponify the fat.—D. B.

New Books.

HANDBOOK OF PATENT LAW OF ALL COUNTRIES. By W. PHILLIPS THOMPSON, C.E., F.I.P.A., etc., of Liverpool. Seventh Edition, Revised, 1886. London: Stevens & Sons, 119, Chancery Lane; New York: D. VAN NOSTRAND, 23, Murray Street. 1886: Entered at Stationers' Hall.

THIS little work has now reached its seventh edition. It is a small octavo volume, bound in cloth, containing 127 pages of subject matter, and a table of contents. The Table of Contents explains

the mode of subdivision of the subject, the subdivisions being well spaced off, and headed in bold type:—**BRITISH PATENTS.** Varieties of Protection. What can be patented. Who can patent. General Rules relating to Patents. First Step in Patenting. Procedure and Cost of obtaining Patent. Subsequent Taxes. Prolongations. Amendments. Revocation of Patents. Infringement of Patents. Legal Proceedings. Licenses and Assignments. **GENERAL HINTS.** What Inventions are Profitable. How to Sell a Patent. Caution to Investors in Patents. How to Safely Invest in Patents. Searching. REGISTRATION. FOREIGN AND COLONIAL PATENTS.

Monthly Patent List.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

9562 E. Böhlig and G. O. Heyne, London. An improved apparatus for eliminating air and gases and carbonate of magnesia from feed water for boilers which have been purified by means of caustic magnesia or basic carbonate of magnesia. Complete specification. July 23
 9563 P. A. Newton, London—Communicated by W. Craig, U.S.A. Improvements in condensers. Complete specification. July 27
 9733 A. G. Meeze, Redhill. Improvements in apparatus for heating and cooling fluids. July 28
 9739 E. Jones and A. Beech, Longport. Improvements in filter presses and the mode of charging same. July 29
 9783 N. Evans, Liverpool. Improved means of obtaining artificial draught under the grates of steam generator furnaces. July 29
 9785 S. Smithson, Bradford. An improved method of and apparatus for heating steam boiler and other furnaces by means of ground coal, or coal-dust, and also for consuming smoke. July 29
 9787 P. D. Bywater and M. J. Bywater, London. Filtering and purifying fluids, called "The London filtering tap." Complete specification. July 29
 9838 E. C. Allam, London. Improvements in filters. Complete specification. July 30
 9845 P. A. Newton, London—Communicated by C. H. Peters & Co., Germany. Improvements in fuel-feeding apparatus and appliances for furnaces. July 30
 9911 C. Otto, London. Improvements in working furnaces by means of compressed air. Complete specification. August 3
 10022 J. Whitley, Leeds. Improvements in the manufacture of apparatus for the distillation and condensation of liquid and gaseous substances. Complete specification. August 5
 10037 E. Edwards, London—Communicated by G. Lunge, Switzerland, and L. Rohrmann, Germany. Improvements in apparatus for effecting the absorption of gases by liquids or solids. August 5
 10085 F. M. Lyte, London. Improvements in the preparation of materials for, and in the manufacture of, cupels and tests. August 6
 10086 F. M. Lyte. Improvements in the manufacture of cupels and tests. August 6
 10098 J. Atkinson, London. Improvements in machines for producing cold air or other gases. August 7
 10128 J. Daglish, London. Improvements in kilns for burning lime, and ores, and other substances. August 7
 10161 G. F. Redfern, London—Communicated by J. J. Imbs, and Messrs. Toison and Fradet, jun., France. Improvements in apparatus for utilising the heat which usually passes off with the smoke in chimneys. August 9
 10169 G. A. Hagemann, London. Improvements in furnaces. Complete specification. August 9
 10233 B. Raymond, London. Improvements in apparatus for elevating water and liquids. August 10
 10272 A. Rathbone, Liverpool. Improvements in apparatus for condensing, heating, or cooling liquids and fluids. August 11
 10370 S. Vickers, Liverpool. Improvements in apparatus for filtering liquids. July 8. Previously included in No. 8205
 10378 C. J. Croft and F. Dowling, Stevenage. Apparatus for forcing draught in boiler furnaces. August 13
 10381 E. Edwards, London—Communicated by K. Welser, Germany. An improved fire-grate for furnaces of all kinds. May 22. Previously included in No. 6919
 10469 S. S. Broughhead, London—Communicated by F. J. Anbladet, France. A smoke-consuming apparatus. August 16
 10505 H. J. Gibson and W. Buck, London. A safety attachment for taps or cocks for gases, vapours, or liquids. August 17
 10552 W. R. Lake, London—Communicated by J. Evans and D. H. Burrell, U.S.A. Improvements in centrifugal apparatus for separating liquids of different densities or specific gravities. Complete specification. August 17

10555 A. Flamache and E. Picard, London. Method of, and apparatus for, desiccating wood and other porous substances. August 18
 10641 D. Rylands, B. Stoner, and R. Potter, Barnsley. Improved arrangements for feeding melting furnaces. August 20
 10663 J. Rankin, Glasgow. Improvements in furnace grates. August 20
 10722 F. Foster, London. Improvements in machinery for charging liquids with carbonic acid gas. August 21

COMPLETE SPECIFICATIONS ACCEPTED.*

1885.

10185 F. Maxwell Lyte. Manufacture of cupels in the cupellation of metals, and production of other refractory apparatus. August 20
 10301 J. H. Selwyn. Liquid fuel furnaces and their appliances. August 17
 10657 F. B. Daring. Apparatus for evaporating sea-water, nitrate, or other solutions or liquids. August 10
 10663 E. Edwards—Communicated by E. Foucault and E. Jaques. Regenerative furnaces for heating air. July 30
 10805 J. Murrie. Apparatus for indicating temperature or pressure. August 13
 11016 H. C. Turner. Oven, furnace, and other door fastenings. July 30
 11312 H. Smith and J. E. S. Perkins. Apparatus for washing and drying various substances. August 6
 11329 P. Teague and W. H. Thomas. Means and apparatus for pumping water, or other liquids. July 27
 11507 J. S. Stubbs and S. H. Stubbs. Water-heating apparatus. July 30
 11903 G. F. Redfern—Communicated by A. Lamart. Apparatus for automatically allowing the escape of gases, liquids, or fluids under pressure. August 6
 11905 W. F. Goreham and W. W. Hewitt. Apparatus for generating steam. August 10
 11920 J. G. Walker. An improved purifier or separator. July 27
 13679 M. Pedersen and J. Nielsen. Mounting the container in centrifugal separators. August 3
 14033 J. Lee. Construction of boiler flues for the consumption of smoke. August 6

1886.

8533 H. E. Newton—Communicated by R. A. Cheesbrough. Steam generators and superheaters. July 30
 8548 H. H. Lake—Communicated by G. E. Bonninghoff and C. F. Jewell. Furnaces for combustion of gaseous fuel. July 30
 8616 G. Seagrave. Apparatus for inducing the flow of air, gas, or other fluid, by means of a smaller volume at high velocity. August 3

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

9598 J. H. Johnson, London—Communicated by E. Delamare-Deboutville and L. P. C. Malandin, France. Improvements in apparatus for carburetting air. July 21
 9616 T. Smith, Newcastle-on-Tyne. Improvements in the arrangement for burning liquid fuel for steam-boilers and other purposes. July 26
 9694 T. Mace, London—Communicated by the Vitrite and Luminoid Company, U.S.A. New or improved manufacture of the incandescing portion or luminant of incandescence electric lamps. July 27
 9695 T. Mace—The Vitrite and Luminoid Company. The manufacture of materials for use as the incandescing medium or luminant of electric lamps, for electrical resistances, or for other purposes. July 27
 9696 T. Mace—The Vitrite and Luminoid Company. New or improved treatment or manufacture of materials for use as the incandescing medium or luminant of electric lamps, or for other purposes. July 27
 9737 A. Brin, London. Improvements in apparatus for regulating the flow of, and uniting and burning oxygen and hydrogen, or other gases. July 28
 9805 W. Maxwell, London. Apparatus for carbonising filaments for incandescent electric lamps. July 29
 9806 C. A. von Welsbach, London. Method of obtaining compounds of the rarer metals from their earths for use as incandescence bodies for illuminating purposes. Complete specification. July 29
 9819 F. V. Hadow, Buxted. An improvement in the artificial manufacture of coal so as to render it comparatively smokeless. July 30
 9833 C. S. Bailey, London. A system or mode of, and apparatus for, effecting the more efficient and economical employment of gaseous or explosive fuel in the driving of motive-power engines. July 30

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Specifications thus advertised are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

9866 H. A. Stuart, Bletchley. Improvements in petroleum and other explosive engines. July 31
 9867 J. Thomson King, Liverpool—Communicated by C. Vose, U.S.A. Improvements in extracting paraffin from petroleum distillate. Complete specification. July 31
 9912 A. Gutensohn, London. Improvements in the manufacture of artificial fuel and fire-lighters. August 3
 10088 J. R. Wigham, Dublin. Improvements in the means and apparatus employed in illuminating lighthouses, beacons, bays, and establishments or localities requiring artificial lights, which improvements are also applicable to other purposes. August 6
 10328 W. Boggett, London. Improvements in producing fuel by new combinations of combustible materials. August 12
 10540 P. Comte, A. Desaubean, and E. Delarue, London. A chemical fire-lighter. August 17
 10596 W. J. Williamson, Deptford. A fuel economising and smoke-consuming apparatus. August 18
 10600 J. E. Rogerson, J. G. Statler, and J. S. Stevenson, London. Improvements in or connected with electric furnaces or heating apparatus. August 18
 10635 S. S. Bromhead, London—Communicated by H. C. Gambier, France. Improvements in gas-heating apparatus. August 20
 10698 T. Thorp, Whitefield. Improvements in non-regenerative gas lighting. August 21
 10740 F. V. Hadow, Buxted. An improvement in the artificial manufacture of coal so as to render it comparatively smokeless. August 23

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

9551 W. Gunn—Communicated by The Coal Economising Company. Compound for the prevention of smoke in furnaces and fire-places. August 10
 9720 B. Andrae. Generation of gas for lighting and heating, and apparatus therefor. August 13
 10778 H. E. A. Wallis. Apparatus for conducting gas-flame heat to hydro-carbon containing vessels. August 13
 11520 R. Walker. Compound fuel. July 30
 11679 R. Scott. Application of air, water, or other fluids as a motive power. July 20
 15191 N. P. Bargh and A. Gray. Motors actuated by expansion of gases resulting from combustion of fuel. August 3

1886.

1349 W. von Ruckteschell. A new combustible compound. Previously included in No. 15475, of 1885. August 17
 6349 O. Inray—Communicated by J. B. Archer. Process and apparatus for manufacturing water oil gas. August 6
 6449 J. Horton. Apparatus for burning gas for illuminating, heating and cooking purposes. August 17
 6859 A. M. Clark—Communicated by C. A. Paquelin. Apparatus for automatically generating and burning inflammable vapours. August 10
 7847 W. A. S. Thompson—Communicated by G. R. Davis. Means for using inflammable oils as fuel. August 3
 8357 S. Butler. Machinery for the manufacture of compressed fuel from coal. July 27
 8549 H. H. Lake—Communicated by G. E. Benninghoff. Utilisation of gas or vapours for lighting and heating; and apparatus therefor. August 13
 8625 W. G. Appleford. Gas burners for heating purposes. August 3
 8880 H. J. Haddan—Communicated by H. Welsh. Apparatus for promoting combustion of fuel. August 10

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, ETC.

APPLICATIONS.

9550 O. Rose, London. Improvements in apparatus for the distillation of coal, shale, and other materials. July 23
 9921 J. Jones, Glasgow. Improvements in the construction and setting of retorts for distilling shale, coal, and other bituminous substances. August 5

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

9713 J. Y. Johnson, London—Communicated by C. Rumpff, and The Farbenfabriken vorm. Bayer & Co., Germany. Improvements in the manufacture of chinolines or chinoline compounds. July 28
 9751 L. Schad, London. A process for the production of a bluish-black colour. Complete specification. July 28
 10134 Dahl & Co., Leeds—Communicated by E. Elsaesser, Prussia. Improvements in the manufacture of blue dyestuffs, or colouring matters. Complete specification. August 9

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

5038 R. Barringer, J. H. Wallis, and W. Barringer. Preparation of blue colouring matters for laundry purposes. August 13
 8528 C. P. Anderson. Dyes and detergents. August 17

V.—TEXTILES, COTTON, WOOL, SILK, ETC.

APPLICATIONS.

9840 G. Harrison, London. An improvement in making fireproof starch and paint for the purpose of rendering all textile fabrics and wood non-inflammable. July 30
 10035 A. Wilkinson, London. Improvements in the treatment and utilisation of plants and shrubs, barks of trees, and various other useful fibres to be used in all kinds of spinning processes, and to be woven in textile and woven fabrics. August 5
 10053 W. Mather, London. Apparatus for treating textile materials with liquids, gases, or vapours. August 5
 10176 H. R. Randall, London. Improvements relating to the treatment of silk cocoons, raw silk, and the like, and to apparatus therefor. August 9
 10250 J. S. Farmer, Manchester. Improved apparatus for testing the purity of raw cotton. August 11
 10542 T. Holliday, London. Improvements in dyeing textile fibres. August 17

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

9811 M. Raabe, A. C. G. Skynner, and S. Henning. Manufacture of yarns and woven and felted goods from animal and vegetable fibres. August 10
 11561 G. Kassner. Manufacturing caoutchouc, wax, fat, colouring matter, vegetable fibre, fibre wool, etc., from laticiferous plants. August 6

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

9611 G. E. Sutcliffe, Halifax. An improved means, method, or process of dyeing cotton in the sliver for the purpose of producing coloured yarn. July 26
 9776 E. Sutcliffe and G. E. Sutcliffe, Halifax. An improved method of and means for dyeing slivers of woollen, worsted, alpaca, and mohair, for the purpose of making coloured yarn therefrom. July 29
 9777 E. Sutcliffe and G. E. Sutcliffe, Halifax. An improved method of and means for dyeing slivers of silk for the purpose of making coloured yarn therefrom. July 29
 9816 M. Hilton, Prestwich. An improvement in the use and application of materials such as catechu, or catechu, or gambir, combined with animal or vegetable gelatinous matter alone, or in combination with biclornate of potash, alum, or tannic and gallic acids. July 30
 9874 A. M. Clark, London—Communicated by La Compagnie Française du Celluloid, France. An improved process of colouring or producing coloured designs upon celluloid or analogous products. July 31
 10315 H. Renold, Manchester—Communicated by R. Hegnauer, Switzerland. Improvements in the method of and means for dyeing hats and hat materials. August 12
 10718 L. Harmel, J. Harmel, and A. Harmel, London. Rotary apparatus for preparing for dyeing and for dyeing combed wool in bobbins. August 21

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

12159 S. Smithson. Method of and apparatus for dyeing. August 3

1886.

2051 R. H. Ainsworth and E. B. Manby. Apparatus for bleaching by the "Thompson" and other processes, applicable also for dyeing. July 27

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

9556 H. J. Haddan, London—Communicated by J. Roussenu, France. A new or improved process for the extraction of iodine and salts from sea-weed and such like. July 23
 9621 J. H. Galloway and J. W. Galloway, London. Improvements in generators employed in the manufacture of carbonic acid gas. July 26
 9801 The Tyne Alkali Co., Limited, and T. Gibb, London. Improvements in the manufacture of hydrate and salts of baryta and strontia. July 29
 10000 A. W. Gillman and S. Spencer, London. Improvements in means or apparatus employed in the manufacture of sulphites. August 1
 10008 J. S. Kipping and F. Seadder, Manchester. Improvements in obtaining certain solutions of iron and in methods of preserving such solutions. August 4
 10009 H. H. Lake, London—Communicated by Count R. de Montglas, United States. Improved apparatus for the manufacture of chlorine gas. Complete specification. August 4
 10011 H. H. Lake—Communicated by R. de Montglas. Improvements in the manufacture of chloride of aluminium and double chloride of aluminium and sodium. Complete Specification. August 1

10013 H. H. Lake, London—Communicated by R. de Montgela. Improvements in apparatus for the manufacture of chloride of aluminium and double chloride of aluminium and sodium. Complete specification. August 1

10036 A. A. Croll, London. Improvements in the distillation of ammoniacal liquor. August 5

10018 E. Vandenhoff, London. Improvements in the manufacture of vinegar. August 5

10119 G. Jarmay, Liverpool. Improvements in separating the ammonium chloride from liquors obtained in the manufacture of soda by the ammonia soda process. August 14

10191 J. Barrow, London. Improvements in the manufacture of alkali. August 16

10095 E. Jacobsen, London. Improvements relating to the production of sulphurated hydrocarbons, and to the extraction or preparation therefrom of sulphonic acid, and other substances. August 20

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

11129 G. L. Wigg, M. Steele, and M. J. Wigg. Apparatus for treatment of residuals from copper works and chlorine manufacture to obtain pigments and sulphate of lime. August 13

11178 P. A. Mawdsley and T. Macfarlane. Manufacture of sulphur and ferric oxide from alkali waste by means of metallic chlorides. August 10

1886.

7801 J. V. Johnson—Communicated by F. von Heyden. Manufacture of salicylic acid and its substitution compounds. August 6

8153 J. V. Johnson—Communicated by C. Kolbe and C. Reitsch. Manufacture of alpha- or beta-carbonaphthol acid alkaline salts. August 6

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

9650 J. Armstrong, London. Improved machinery and appliances for the manufacture of rolled glass. July 27

10019 E. Walsh, jun., London. An improved method of and apparatus for rolling plate glass. Complete specification. August 5

10075 A. D. Brogan, Glasgow. Improvements in the manufacture of rippled glass, and in apparatus therefor. August 6

10165 L. de Borlodot and J. Quinet, London. Improvements in the manufacture of cylinder glass. August 9

10271 E. Townsend and T. H. Thompson, Birmingham. Improvements in coloured glass or other ornamental glass screens. August 11

10574 A. Drummond, Glasgow. Improvements in the manufacture of glass and in the application of the same for roof lights and other glazing purposes. August 18

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

11395 A. D. Brogan, Glasgow. Manufacture of plate glass, and apparatus therefor. July 27

11589 A. M. Clark—Communicated by La Société Appert frères and La Société Geneste-Herschier et Cie. Process and apparatus for manufacturing perforated glass. August 10

11681 W. Jones. Means for drying bricks, porcelain, terracotta, or earthenware, etc. August 3

12011 J. Pratt. Process of gilding glass. August 13

1886.

8695 J. Plant. Machinery for turning pottery ware. Aug. 3

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

9536 E. T. L. Clark, London. An invention to be known as Laxton's improvements in hardening and preserving plaster of Paris (sulphate of lime) casts and moulds, making them impervious to water, and rendering unnecessary the ordinary process of white-washing or painting. July 23

9511 C. Duncombe, London. An improved method of laying asphalt or other kindred substances. July 23

9729 T. Bayley, Birmingham. Improvements in the colouring of marble and other materials composed of calcium carbonate. July 28

9981 J. Davies, Manchester. Improvements in the method of and in apparatus for preparing clay for use in brick and tile making. August 1

10167 P. Jeserich, London. A new or improved artificial asphalt and process for manufacturing the same. Aug. 9

10182 J. W. Breakell and T. Breakell, Manchester. An improved material for decorative purposes. August 10

10329 H. D. Cunningham, London. Improvements in the construction of chambers for drying Portland cement, slurry, bricks, or tiles, etc., by heat. August 12

10514 H. J. Hadden, London—Communicated by H. Deschamps, France. Improvements in tiles. August 17

10693 C. Drake, London. Improvements in artificial stone. August 20

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

9881 F. Shorten—Communicated by A. Raehner. Manufacture of stucco objects and surfaces. August 3

10331 R. Stone. Manufacture of cement and apparatus therefor. August 17

11684 W. Jones. See Class VIII.

11806 W. T. Timewell. Manufacture of cement. August 10

12390 J. S. Armstrong. Improved forms of building materials. July 30

12405 J. J. Allen. Machinery for manufacture of bricks and tiles. August 3

12814 W. R. Lake—Communicated by J. P. E. Durst and L. Vidrie. Apparatus for impregnating wood with preservative and other fluids. July 30

1886.

7671 H. Mathey. Manufacture of cement. August 10

8331 F. C. A. Meier. Centrifugal apparatus for moulding clay, cement, plaster, etc. August 10

X.—METALLURGY, ETC.

APPLICATIONS.

9630 G. Nurse, London. An improved method of treating or operating upon black plates previous to tinning or tinning. July 26

9661 C. E. Moneriff, Belfast. Improvements in means of raising rock salt from the mine. July 27

9663 M. R. Moore, London. Improvements in machines for making sand moulds for casting metals. Complete specification. July 27

9664 M. R. Moore. Improvements in machines for making sand moulds for casting metals. Complete specification. July 27

9700 H. J. Hadden—Communicated by L. Fleury, France. A new or improved process for annealing copper and its alloys. July 27

9711 A. J. Boulton, London—Communicated by E. Hamélin, France. Improvements in or relating to cupolas and blast furnaces. July 27

9731 A. G. Mecze, Redhill. A process and arrangement of apparatus for the purification of pig-iron and the conversion thereof into steel or homogeneous metal of higher grade. July 28

9815 J. Pinder and B. Woodcock, Bradford. Improvements in the method of hardening and tempering steel wire. July 30

9919 E. W. Parnell and J. Simpson, Liverpool. Improvements in the treatment of ores containing sulphide of antimony, for the purpose of obtaining such sulphide in a concentrated form, with any gold and silver that may be present. August 3

9926 H. J. Allison, London—Communicated by J. Robertson and J. Hardie, United States. Improvements in hydraulic lead presses for coating wire and cable with lead. Complete specification. August 3

10062 W. P. Thompson, Liverpool—Communicated by W. H. Wright, United States. Improvements in the manufacture or working of metals in a cold state into certain forms, and in apparatus therefor. August 6

10085 and 10086 F. Maxwell Lyte. See Class I.

10089 R. Heathfield, London. Improvement in apparatus used for coating sheets of iron and steel with zinc or alloys of zinc or other coating metal or alloy. August 6

10227 H. R. Lewis, C. B. Phillips, and C. J. Sandahl, London. Improvements relating to the extraction of metals from refractory, complex, and other ores. August 10

10241 H. H. Lake, London—Communicated by E. Thomson, United States. Improvements relating to the welding of metals and to apparatus therefor. Complete specification. August 10

10277 H. E. Newton, London—Communicated by A. Nobel, France. An improved mode of disintegrating rock by heat. August 11

10353 P. Barry, London. An improvement in the manufacture of iron for the production of a hardening and tempering metal or steel. August 12

10177 W. A. Thoms, London. Improvements in the deposition of platinum by electricity. August 16

10506 H. Tabor, London. Making moulds for foundry purposes. Complete specification. August 17

10517 J. W. Jones and R. S. Harrison, Blyth. Kirving or cutting coal and other minerals. August 17

10591 J. Clark, London. Improvements in the process of obtaining alloys of aluminium with copper and with other metals. August 18

10605 W. R. Lake, London—Communicated by Count R. de Montgela, United States. An improved process of extracting aluminium from chlorides of the same, and of aluminium and sodium. Complete specification. August 18

10606 W. R. Lake—R. de Montgela. An improved process of extracting aluminium from its chlorides. Complete specification. August 18

10607 W. R. Lake—R. de Montgela. Improvements relating to the electro-deposition of aluminium. Complete specification. August 18

10753 R. Schneider, Berlin. Improvements in separating-funnels or kits used for making perfectly solid and pure castings of iron, steel, or any other metal. August 23

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 10185 F. Maxwell Lyte. See Class I.
10752 E. Dawson, A. T. Harvey, and J. Bow. Mode of and plant for manufacturing wrought-iron or steel sleepers. July 30
11402 B. H. Thwaite. Decarbonising, desilicifying, dephosphorising, and desulphurising fluid iron metal, and apparatus therefor. August 13
11199 J. S. Sellon. Process and means for soldering aluminium. July 27
11538 A. M. Clark—Communicated by C. Cholat and F. Mercier. Treating and purifying cast iron, and apparatus therefor. August 3
11624 E. R. Blundstone. Utilising waste tin, tin plate, lead and terne plate. August 13
11798 O. Inray—Communicated by L. Bondy. Process of extracting wrought iron and steel directly from ores. Aug. 6
11854 B. D. Healey. Method and apparatus for making steel. August 10
12355 W. Edmunds. Blast furnace. July 30
12501 J. W. Summers and T. Sharp. Working light scrap iron, etc., in making steel bars. August 10
12615 G. Allen and T. Turner. Appliances for producing ingots compounded of iron and steel. August 6
12616 G. Allen and T. Turner. Manufacturing variegated metal for twist barrels, etc. July 30
12756 J. Riley. Regenerative steel-making furnaces. August 17
12891 J. E. Sherman. Manufacture of iron and steel. August 3
12909 S. Pitt—Communicated by J. Weirich. Treatment of auriferous and auro-argentiferous minerals. August 3

1886.

- 6690 R. Richards and H. R. Landon. Means and apparatus for boring to great depths for water and minerals by the aid of electricity. July 30
8338 T. Twynam. Refractory linings for metallurgical furnaces, etc. July 27
8833 C. B. Headly. Gold-covered alloy. August 6
8988 T. Fenwick. Treating waste tin cuttings to recover tin and iron fit for remanufacture, and apparatus therefor. August 10

XI.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

- 9553 T. Schofield, Bradford. Reclaiming oil or other lubricants from cleaning cloths, greasy cotton-waste, and the like. July 23
9591 J. Thomson, London. An improved antiseptic soap. Complete specification. July 21
10226 H. H. Lake, London—Communicated by N. J. Clute, P. B. Rose, and J. M. Aubrey, United States. Improvements in the manufacture of soap. Complete specification. Aug. 10
10395 G. W. Bremner, London. A new or improved method of treating materials for the manufacture of washing liquids and cleansing powders. August 13

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 11561 G. Kassner. See Class V.
11726 W. Marriott and H. Marriott. Improving the viscosity of oils. August 20

1886.

- 8921 J. Whittle. Apparatus for separating oil or grease from cotton-waste, etc. August 10
8933 J. L. Mott, jun.—Communicated by Dreher & Co. Lubricating compounds. August 13
9115 H. H. Lake—Communicated by W. B. Albright. Bleaching fats and oils. August 20

XII.—PAINTS, VARNISHES, AND RESINS.

APPLICATIONS.

- 9581 J. B. Hannay and E. J. Pape, Glasgow. Improvements in making white paint. July 21
10127 E. Schroder and H. Perner, London. An improved process for giving a non-oxidising, or only slightly oxidising coating to wood and other materials or objects. August 7
10238 F. Maxwell Lyte, London. Improvements in the manufacture of white pigment. August 11
10391 G. W. Bremner, London. A new or improved method of operating on animal and mineral material for the manufacture of a paint suitable for ships' bottoms and other submerged bodies. August 13

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 11177 O. Inray—Communicated by E. A. Behrens. Bleaching and refining resins, etc. August 13
11529 E. L. Kitchingman and A. Andrews. Waterproof and anti-corrosive composition for coating ships' bottoms, etc. July 27

- 11543 G. W. Carr and J. Dickinson. Anti-fouling composition for coating ships' bottoms, metal, wood, etc. July 27
12249 S. Banner. Substitute for turpentine. August 13
12723 T. C. Huntington and M. Chiapponi. Treating antimonial ores or compounds to obtain pigment. August 17

1886.

- 7975 A. Buel. Method and apparatus for drying pigments, etc. August 3

XIII.—TANNING, LEATHER, GLUE AND SIZE.

APPLICATIONS.

- 9604 W. Ross, London. Novel application of a material or substance produced by the treatment of waste leather. July 24
9613 T. Laycock, Northampton. An improved method of making leather and other materials flexible to any degree, and of waterproofing the same, so as, when used for the manufacture of boots and shoes or other articles, the same are damp and waterproof, and may be made flexible to any degree required. July 26
9771 J. Vassie, jun., Glasgow. Improvements in operating the tables of leather-dressing and hide-working machines. July 29
10347 G. W. Bremner, London. A new or improved treatment of substances containing phosphoric acid and alumina, for the manufacture of a mineral gum and glue. August 12

XIV.—AGRICULTURE, MANURES, ETC.

APPLICATIONS.

- 9636 L. A. Chevalet, London. A new or improved process for manufacturing neutral phospho-guano. July 26
9847 T. H. Cobley. See Class XVIII.

XV.—SUGAR, GUMS, STARCHES, ETC.

APPLICATIONS.

- 9569 W. Burns. See Class XVII.—B.
9726 C. Tully, Newcastle-on-Tyne. An improvement in the manufacture of indiarubber, gutta-percha, and combined indiarubber and gutta-percha sheets, pipes, washers, etc., by the incorporation of mica with the indiarubber and gutta-percha used in the manufacture of such goods. July 28
9992 A. G. Wass, London. The improved utilisation of lime and other calcareous material impregnated with saccharine matter. Complete specification. August 4
10161 H. J. Haddon, London—Communicated by A. Z. Champy, A. N. Champy, and L. P. Champy, Belgium. Improvement in the treatment of Jerusalem artichoke to prepare it for use in distilling, in the manufacture of glucose, and similar industries. August 9
10257 C. Lyle and J. Lyle, London. Improvements in the manufacture of lump sugar. August 11
10481 M. Strasser, London. A process for the manufacture of artificial gum. August 16

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 11561 G. Kassner. See Class V.
11671 J. Bagnall. Dissolving vulcanised indiarubber and indiarubber compounds. July 30

XVI.—BREWING, WINES, SPIRITS, ETC.

APPLICATIONS.

- 9551 A. G. Fraser and G. Epstein, London. Improvements in treating distillers' worts in separating yeast therefrom, and in treating yeast.
9630 L. Béchaux, London. Improvements in the distillation and the rectification of alcoholic and other liquids. Complete specification. July 26
9658 F. Faulkner and W. Adam, London. An improved appliance for use in circulating and aerating malt and raw grain worts when producing ordinary malt liquors, distillers' wash, and vinegar brewers' wash, applicable also to other processes. August 3
10164 H. J. Haddon—Communicated by the Messieurs Champy. See Class XV.
10376 D. W. Hamper and J. H. Howell, London. Improvements in brewers' coppers and other like or analogous vessels. Complete specification. August 13
10722 F. Foster. See Class I.
10761 F. Heyman, London. An improved syphon suitable for storing beer. August 23

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 9956 C. R. Bonne. Apparatus for testing brewing materials. August 10
11935 W. S. Squire. Manufacture of yeast. August 10

- 1208 W. S. Squire, Manufacture of yeast, August 10
12163 W. S. Squire, Manufacture of yeast, August 13

1886.

- 8161 Sir F. Bolton, Process for fining beer, July 27
9131 H. W. Lafferty, Utilisation of the refuse or slops of breweries, distilleries, etc., August 20

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

APPLICATIONS.

A.—CHEMISTRY OF FOODS.

- 9712 E. R. Allen and W. C. Allen, London, Improvements in the manufacture of articles of food made from the kernels of almonds and other fruit, July 27
9738 A. Brin, London, Improvements in treating milk for preserving it, July 28
9865 J. Mackenzie, Cork, Preservation of butter, or other substances, in packages, July 31
10076 A. Dintour, Manchester, A process for making the bones in fishes eatable, August 6
10170 H. J. Haddon, London—Communicated by M. Blumenthal, Germany, Improvements in the manufacture of rennet, Complete specification, August 9
10518 A. H. Reed, London—Communicated by R. Ellin, United States, Certain improvements in the production of evaporated milk, Complete specification, August 17
10772 W. R. Lake, London—Communicated by M. A. B. Mount, United States, An improved substitute for coffee, August 23

B.—SANITARY CHEMISTRY.

- 9569 W. Burns, Leith, Improvements in the manufacture of deparating and decolorising charcoal for purifying sewage and other foul liquids, and for decolorising syrups, July 24
9847 T. H. Cobley, London, Improvements in the treatment of sewage, the manufacture of a precipitant therefrom, and the treatment of the resulting product for the preparation of a manure or fertiliser, July 30
10017 W. Astrop, London, Improvements in the apparatus and process for solidifying and drying sewage sludge and such like articles, August 5
10703 E. Segeant, Bolton, Improved furnaces for treating materials infected with disease, and other refuse, August 21

COMPLETE SPECIFICATIONS ACCEPTED.

A.—CHEMISTRY OF FOODS.

1885.

- 12178 A. G. Brookes—Communicated by T. S. Nowell, Baking powders, August 13

B.—SANITARY CHEMISTRY.

1885.

- 11255 G. R. Keeling, Destroying noxious smells and gases in sewers by the action of flame, etc., August 20
12261 J. Hanson, Process and means for disinfecting, deodorising, and purifying sewage, etc., August 10
16000 J. H. Kidd, Purification of sewage from organic matter, August 13

1886.

- 1792 F. Candy, Preparation of materials for the treatment of sewage, etc., August 13

XVIII.—ELECTRO-CHEMISTRY.

APPLICATIONS.

- 9582 J. P. Hall, Manchester, Improvements in dynamo-electric machines, July 21
9594 H. Weymersch and J. Whittall, An improved battery solution, July 21
9635 and 9636 T. Mace—The Vitrite & Luminoid Co. See Class II.
9841 F. E. Elmore, London, Improvements in dynamo-electric machines, July 29
9855 O. March, London, Improvements in primary batteries of the manganese or Leclanche type, July 30
9901 H. Aron, Glasgow, Improvements in electric batteries, August 4
10222 E. Andreoli, London—Communicated by J. V. Warnou, Paris, Improvement in voltaic batteries, August 10
10286 F. H. W. Higgins, London, Improvement in voltaic batteries, August 11
10319 W. Haberlein, Berlin, Improvements in secondary batteries, August 12
10536 E. D. Kendall, London, A new and useful composition of matter to be used as an electric battery excitant, Complete specification, August 17

- 10569 C. H. L. Clarke, Manchester, Improved mechanical means of hermetically sealing electric batteries, August 18
10581 E. M. Gardner, London—Communicated by T. L. Kauffer, United States, An improved galvanic battery, August 18
10641 A. Millar, Glasgow, Improvements in electrodes for secondary batteries, Complete specification, August 20
10765 W. Lowrie and C. J. Hall, London, Improvements in secondary generators for the conversion of electrical energy by induction, August 23

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 10616 H. H. Lake—Communicated by S. F. Van-Choate, Armatures for electric generators and motors, August 3
11307 C. Moseley and T. Parker, Secondary voltaic batteries, July 27
11451 T. J. Jones, Voltaic batteries, July 27
11652 T. J. Jones and W. H. Tasker, Manufacture of plates or elements for voltaic batteries, July 30
12288 H. Thame and J. R. Thame, Secondary batteries, August 17

1886.

- 7541 H. J. Smith, Dynamo-electric machines, August 13
7840 S. F. Thompson, Dynamo-electric machines, Aug. 3
8151 J. G. Tongue—Communicated by J. Kirby, Manufacture of carbons for electrical purposes, August 20
8501 W. L. Gates, Portable galvanic batteries, August 17
9103 A. J. Boulton—Communicated by O. Lago, Galvanic batteries, August 20

XIX.—PAPER, PASTEBOARD, Etc.

APPLICATIONS.

- 9885 R. Kron, London, Improvements in machinery for grinding, mixing, sizing, dyeing and otherwise preparing materials for the manufacture of paper, July 31
10267 J. B. Scammell, London, Improvements in the manufacture of paper for cigarettes, Complete specification, August 11
10293 C. L. Lawrence, London, A process for rendering paper impervious, August 11
10356 J. Brandt, London, Improvements in pulp and half-stuff machines, August 12

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 11876 C. Jackson, Manufacture of hardened asbestos, August 10
13022 F. G. Morton and N. Salamon, Manufacture of pulp or "half-stuff," utilising refuse material, August 6

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

APPLICATIONS.

- 10280, J. Y. Johnson, London—Communicated by F. von Heyden, Germany, A process for the manufacture of oxy-chinoline carbonates, Complete specification, August 11
10281 A. Knoll, London, Process for the production of the ethers of morphinecarbonic acid, August 11
10357 A. Knoll, London, Process for producing methyl-morphin (coduin), ethyl-morphin and higher homologues of morphin, August 13

XXI.—EXPLOSIVES, MATCHES, Etc.

APPLICATIONS.

- 9615 J. R. Linsley and J. H. Proctor, Newcastle-on-Tyne, Improvements in cases or canisters for containing or carrying gunpowder or other explosive, July 26
9632 J. Pain, London, Improvements in fireworks, July 27
10330 G. Beattie, Glasgow, Improvements in lucifer matches and in manufacturing the same, August 12
10437 C. D. Abel, London—Communicated by W. Lorenz, Germany, Improvements in percussion fuses for projectiles, August 11
10580 D. Johnson and W. D. Borland, London, Improvements in ammunition, August 18
10728 G. A. Sweetser, London, Improvements in the manufacture of cigar lights, fuses, or vesuvians, August 21

XXII.—GENERAL ANALYTICAL CHEMISTRY.

APPLICATION.

- 10345 L. Brockmann, London, Combinations of gelatine with chloride of cobalt, chloride of copper, and nitrate of nickel oxyd for indicating the moisture of the atmosphere, August 12

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NOTICE.

The supply of copies of the Journal for January, 1882, being now exhausted, the Secretary would be glad to receive communications from members possessing extra copies of that number, in good condition, with a view to purchase.

Should sufficient applications for complete sets be received, the number will be reprinted.

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London Section.

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The meetings of the London Section will be held on the first Monday in each month.

Prospective Arrangements.

Nov. 1.—Mr. Lewis T. Wright, F.C.S., C.E., "What shall we do with our Tar?"

Dec. 6.—Mr. Tonrehsel, "On Strontium Hydrate." Mr. Fairley, F.C.S., "Comparative Experiments on Various Forms of Sprengel Pumps."

Jan. 3.—Mr. Watson Smith, F.I.C., F.C.S., "On the Explosive, 'Kinetite.'"

Notices of papers and communications for the meetings to be sent to the Local Secretary.

PRESERVING STANDARD TARTAR-EMETIC SOLUTIONS.

BY ARCH. R. MILLER.

HAVING occasion frequently to estimate the tannic acid in samples by means of tartar-emetic, I found it very troublesome to make up a fresh standard solution every time I made the estimation. The inside of the bottle containing the tartar-emetic solution invariably turned white after standing for an hour or two. I discovered that by excluding the air from the solution it would keep for any length of time without decomposition taking place. By placing the solution in a bottle with a well-ground close-fitting glass stopper (which, to ensure a good fit, may be rubbed before insertion with a little lard or vaseline), and after bottling the solution and melting some spermaceti round about the stopper, the solution may be kept without fear of change. It is advisable, however, not to make too large a quantity at one time, or if so it must be kept in different bottles—say, of a capacity of 500cc. each—as each time the stopper is withdrawn a small quantity of air gets in. If the stopper is quickly replaced and sealed after abstracting the required quantity of the solution, any decomposition which may take place is very slight, and by the time 500cc. of solution are used, is very trifling.

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Notices of papers and communications for the meetings to be sent to the Local Secretary.

ERRATA.—In Mr. Ad. Steiger's paper, in the July number (pages 416—421), where the capacities of Gerson's filters are given, for "hectolitres" read "cubic meters" in every case—namely, on pages 418 and 420.

THOMAS-PHOSPHATE SLAG, OR BASIC CINDER IN THE STATE OF POWDER, AS A HIGHLY ACTIVE PHOSPHATIC MANURE.

BY WATSON SMITH, F.C.S., F.I.C.,

Lecturer in Chemical Technology in the Victoria University, Manchester.

EVERY agriculturist at the present time will be interested in a question which is exciting very great attention in Germany just now—viz., the use of powdered basic cinder as manure. The German experimenters find that a general treatment with sulphuric acid is, in many cases, wholly unnecessary and therefore wasteful, since the conversion into superphosphate designed to render soluble the phosphoric acid of the slag, and the preparation from the slag of precipitated phosphate are processes which are mostly too expensive. It is now known that, especially in the case of certain soils and earths, the phosphate of the basic slag is *gradually*, but quite speedily enough, rendered soluble for assimilation by the vegetation to which it is applied as manure; indeed, to have it more soluble would mean more or less loss by sinking into the earth beyond the zone of usefulness. Anyone doubtful of the statement of the great interest in the utilisation of basic cinder awakened in the German Fatherland among those interested in agriculture, should procure and read the stirring articles which appeared in the *Frankfurter Zeitung* for Sunday, August 22. It is, however, matter for a certain amount of congratulation that the Society of Chemical Industry has not been behind, but fully equal to the occasion, and that one of its members, Dr. J. M. H. Munro, of the Downton College of Agriculture, with Professor J. Wrightson, has for some time past been experimenting in the direction referred to; and that these gentlemen are fully alive to the importance of the question is evident to all who read the valuable report noticed under New Books in our July number, page 437. The writer was informed in Germany that German buyers have been sent over to this country empowered to buy up all the basic slag they can find available, so that what have been unsightly rubbish-heaps and waste ground, will now contribute to the produce and increase of the verdant pastures and of the fruitful plains. It is a fact, that already cargoes of the waste material referred to (the phosphoric basic cinder) have been shipped from Middlesbrough to Germany, Denmark, and Sweden, and the present rate of shipment to the Continent (September 12, 1886) is something like 1200 tons per week.

Messrs. H. & E. Albert, of Biebrich-am-Rhein, manufacturers of manures, etc., and specially interested in the Thomas-basic cinder, have issued a very instructive circular, which, since it contains much useful information, and being a record of observations partly of their own, is well worthy of reproduction. Of course, since the document in question bears the character of a trade circular as well as a record of observations, the writer must give the statements for what they are worth, and without the endorsement that could be accorded after personal experimental verifications. Nevertheless, the names quoted are of fully sufficient authority to warrant not only publication, but a most careful consideration by ironmasters and agriculturists alike.

By the combustion of the phosphorus in phosphoric iron in presence of lime, millions of hundredweights (centners) of fused phosphate of lime are prepared, and as fused slag are run off from the steel formed at the same time. On the average this Thomas-slag or basic cinder contains 16–20 per cent. of phosphoric acid, and 46–54 per cent. of lime and magnesia.

At first a chemical treatment of the slag so as to form superphosphate and precipitated phosphate was attempted, but this was not found to pay owing to the high percentage of lime present; experiments in the field meanwhile, made upon peaty soil and moorland, sour and wet meadowland, have shown excellent results, as Dr. Fleischer, director of the Experimental Station for Moorland Agriculture, near Bremen, has demonstrated by hundreds of experiments carried out on the large scale. Employed on ordinary field and meadowland it was, however, unexpectedly found in the very first harvests, that considerable improvement and increase were the result, equal to what has been obtained with a superphosphate containing an amount of soluble phosphoric acid double that contained in the ground cinder. As in acid soils, so also in those kinds of soils that are poor in lime, specially high results were obtained, because of the large amount of lime in the ground cinder (*Schlackenmehl*), which had contributed to supply the deficiency of lime in the soil.

It was chemically proved that this form of calcium phosphate—i.e., that in the cinder—is very easily soluble, proving quite soluble in waters containing carbonic acid, and in neutral ammonium citrate solution when the latter was employed in sufficient quantity. H. Albert found that 1 part of ground basic cinder with 100 parts of peat and 500 parts of water in two weeks yielded 94 per cent. of its phosphoric acid in a form soluble in water. A humic acid salt of lime, and free phosphoric acid soluble in water, are formed, and at the same time only small quantities of ferrous oxide were rendered soluble. These results prove that all the phosphoric acid that was combined with the lime is soluble in the natural acids of the soil, and is in a form easily taken up by the roots of the plants. The innocent nature of the ferrous oxide of the cinder, which is with difficulty soluble, is clear from the chemical behaviour in the peat, as also from the field experiments in which, when even more than 20 centners of ground basic cinder per $\frac{1}{2}$ hectare were used, showed no injurious action on the seed and crops; it may thus be assumed that these oxides of iron are just as insoluble as those naturally present in the usual soil itself. In a great number of manurial experiments in the field and analytically, it has consequently been proved beyond a doubt that this slag phosphate is a highly active and valuable phosphate manure. Professor Wagner, of the Darmstadt experimental station, has established its action in 235 exact manurial experiments performed upon four different kinds of soil, and further proved that

by fine grinding of the cinder, the action of its phosphoric acid on the average, when used in double the quantity of superphosphate-phosphoric acid, soluble in water, is equally active in the first crop. A complete confirmation of Wagner's results was obtained by Professor Fittbogen, of the experimental station of Dahme, in a series of exact experiments extended to oats and potatoes. In the latter case the ground basic cinder, comparing it with superphosphate and precipitated phosphate, according to the phosphoric acid contained in the substances, was found, weight for weight of phosphoric acid contained, equally effective. Messrs. Albert quote the experiments at Downton, by Dr. Munro, and the high crop results there obtained with ground cinder. For the still further improvement based on the use of mixtures of ground cinder and superphosphate Dr. Munro has taken out a patent (see this Journal, vol. v. page 433; Eng. Pat. 7740, June 25, 1886). The experiments on meadow land by Munro and Wrightson, in England, gave good results, coinciding with those obtained in Germany.

From the thousand-fold experiments tried, the following very important data for agricultural science, have been derived: That the Thomas basic cinder, when reduced by grinding to the finest possible condition, is more quickly effective than ground bones, is to be preferred in clayey and sandy soils poor in lime, in wet meadows of acid character, mossy, and for clover fields. In soil rich in lime, when manured with a three-fold quantity, equally greatly increased results were obtained to begin with, but in addition, the good results were more lasting.

For moorland, wet and sour meadows, two centners per $\frac{1}{2}$ hectare (Morgen) are used, and the land is manured annually; in case of necessity a potash salt manuring is also given, or three centners of ground cinder containing potash are used in the manuring. On sandy and clayey earths poor in lime it is necessary to use four centners for a triennial manuring, in earths rich in lime six centners for four years. If the intention be to enrich the land for from six to eight years in phosphoric acid and lime, then it may be manured with 10 centners and more per $\frac{1}{2}$ hectare. A lucerne field, the crops of which need on the average 26 pounds of phosphoric acid per annum, should be manured with 16 centners of powdered basic cinder if it is to furnish good crops for 10 years; if after from four to five years a falling off takes place, potash is probably deficient in the soil, and then clover can be obtained in full crop by adding in the winter every two years, by means of an after-manuring, 6 centners of kainite.

Since the powdered basic cinder by its content of lime disintegrates still further in the air and soil, and thereby becomes more soluble and active, it is advised to apply it to the soil as early as possible; it can be strewed on the meadows after each hay harvest and let lie over the winter, and when possible be raked into the soil. On fields, it can be strewed and let lie upon the stubble until it is ploughed in, the heavy cinder powder sinks in soon, and a loss is not to be feared. The ploughing into the soil must, however, take place so that the cinder manure may lie where the moisture is mostly retained, and the roots spread themselves. If the basic cinder manure is ploughed in directly before the seed is sown, the plants do not, it is true develop so quickly in the first month as would have been the case with superphosphate, but after six weeks the positions would be the same. It must be assumed that all classes of soil are partially exhausted of phosphate, because an enrichment with it, as a consequence, affords everywhere great in-

crease in the yields of the crops. With powdered cinder and potash salt, the constituents of the ash of the plants are completely given, and consequently that which is understood by the name of the "strength of the soil" ("Bodenkraft"). Various plants, and happily the chief ones used as fodder—butterfly orchis, clover, lucerne, vetches, lupins, peas, beans—need only this mineral nourishment in order to flourish to the full, and to yield large crops of the best hay. The high yields of fodder attained at the same time lead to a class of hay much richer in vegetable albumen, starch-sugar and fat. Besides a well-nourished stock of cattle, a richer stable manure is obtained, whereby the grain, rapeseed, cabbage, potatoes, and beets are caused to yield larger crops, and the landed property is rendered profitable with very small outlay.

It is recommended that every two years gardens be manured with powdered basic cinder, the consequence being that on subsequent treatment with stable or the nitrogenous dung-manures, the latter will be doubly effective. Like the beets and cabbage in the field, all vegetables, flowers, fruit trees, and vines will be found to yield double and fourfold, and also, through strong healthy growth, to be less sensitive to the attacks of insects, etc. One reason, of course, why the powdered basic cinder is so useful, and is superior to the superphosphate for moorland and damp meadowland, is just by reason of its being more insoluble than the latter, which too easily sinks deep into the earth or gets washed away*; but even in drier soils its greater stability and more gradual action is preferable, and the English field experiments referred to show that in the most extreme cases a mixture of the powdered cinder with superphosphate will raise the yields greatly even in the driest summer weather.

It is calculated, as regards price, that at present 1 lb. of phosphoric acid in the form of the Thomas basic slag powder, could be delivered for about 1d. (10 Pfennige); also, by means of a subsidiary dunging with $\frac{1}{2}$ to 1 centner of Chili saltpetre per $\frac{1}{4}$ hectare, ground bones and guano can be replaced, and the best harvests obtained in a far cheaper manner than formerly.

Chili saltpetre (nitrate of soda) and potash salts can of course be mixed with the powdered cinder to begin with, and the whole furnished as a special manure, but not so sulphate of ammonia, which, in the presence of the lime of the basic cinder, would lose ammonia.

The grinding of the basic cinder must be very thorough, so as to yield a very fine powder, and upon this very much depends its usefulness. The firm in question (Messrs. Albert) find it best to furnish a powder of which they guarantee 90 per cent. shall fall through a $\frac{1}{2}$ millimeter sieve.

EXPERIMENTS IN THE PREPARATION OF ULTRAMARINE WITH JAPANESE KAOLINS.

BY K. IWABUCHI.[†]

THE kaolins which the author took for his experiments are those of Gotō, Gairome, Harima, Yamato, Tororoishi, Tonoguchi, Shigaraki, and Shiraye. The analyses of them are given in the table on next page.

No doubt another reason is, that the basic cinder contains excess of lime, which neutralises the excess of acid in such sour lands.

[†] 1 hectare = 10,000 sq. metres = 2.47 imperial acres.

[‡] Abstracted from Graduating Thesis, and communicated by T. Takamatsu, Lecturer in Applied Chemistry, Imperial University, Engineering College, Tokyo, Japan.

1.—GOTŌ KAOLINS (A and B).

These kaolins occur as a fine white powder in the island of Gotō, on the southern coast of Nagasaki. Both qualities, A and B, in the carbonate mixture, yielded a light green mass, shrinking regularly on calcination. This mass, after blueing, was found to be rather dull in colour. This is perhaps due to a large amount of potash in the kaolins, as seen in the above table.

2.—GAIROME KAOLIN.

This is a greyish white powder used for the body of porcelain, at the village of Seto in Owari. Although a green mass was produced on calcination of the carbonate mixture, yet it shrunk irregularly, and the blue produced was not good, perhaps due to the presence of too much iron and potash in the clay.

3.—HARIMA KAOLIN.

A grey stone which, when powdered, has a white colour. It is called Rōseki, in Japan, being used for sculpture purposes. Experiments were tried several times to prepare ultramarine from the kaolin, but without any successful result. This is no doubt due to a great excess of silica present in the clay, the ratio of Al_2O_3 to SiO_2 being 1:3.9. The same is also true for the three following kaolins:—Yamato, Tororoishi, and Tonoguchi, in all of which the ratio of Al_2O_3 to SiO_2 exceeds over 1:3.

4.—YAMATO KAOLIN.

Found at the village of Nakasuji in Yamato. It is a greyish white powder which, on calcination, becomes grey. The carbonate mixture was made with this clay. It gave, on calcination, a semi-fluid mass, but no ultramarine.

5.—TOROROISHI.

This kaolin is found in Amakensa, and is used for porcelain making in Kyōto. Containing too much silica, it is not fitted for the production of ultramarine.

6.—TONOGUCHI KAOLIN.

It is a very white powder, usually employed for making the body of porcelain in Aizu. No ultramarine was formed from this kaolin, as it contains too much silica.

7.—SHIGARAKI KAOLIN.

This is a greyish white clay, and is extensively used for making the body of porcelain in Kyōto. The carbonate mixture on calcination yielded a blue mass, which by a subsequent blueing process gave ultramarine of light reddish shade. The colour, however, was not fine, owing to the presence of too much alkalis and iron.

8.—SHIRAYE KAOLIN.

It is found in Mino, along the river Nasubi, and is used in porcelain works at Seto, in Owari. From the foregoing analysis it will be seen that this kaolin contains very little impurities, and moreover contains Al_2O_3 and SiO_2 in the ratio 1:2. In fact it is a very suitable material for the production of good ultramarine. It was first purified by elutriation, then dried, ignited and pulverised as fine as possible. The carbonate mixture was then prepared in the following proportions, according to Gentile:—

Kaolin	50grms.
Sodium carbonate	50 "
Sulphur	30 "
Charcoal	6 "
	136 "

The mixture, after being calcined for three hours, gave a green mass, which was homogeneous and

fritted regularly. It was washed, ground, and finally treated with sulphur. The ultramarine so obtained had a dark blue colour with some lustre. The weight of the ultramarine was found to be 42grms.—that is, about 30 per cent. of the original mixture.

In order to get ultramarine of lighter shade, the author tried to prepare sulphate ultramarine by taking the following mixtures:—

	I.	II.
Kaolin	50grms.	50grms.
Sodium sulphate	45 ..	50 ..
Charcoal	8.5 ..	8.5 ..
	103.5 ..	108.5 ..

Of these, II. gave a good result, and yielded 44grms. of ultramarine of lighter shades, but without good lustre. The weight of the colouring matter corresponds to about 40 per cent. of the original mixture.

In order to increase the ratio of the Al_2O_3 to SiO_2 , which exist in the Shiraye kaolin, a calculated

ever, the mixed kaolins had been employed to form the sulphate mixture, no ultramarine was obtained on calcination and subsequent treatment.

Experiments were next made with the object of preparing some mixed ultramarines with a view to obtain intermediate shades between the carbonate and sulphate ultramarines, the former being always too deep, while the latter were too light in shades.

The following mixture was then prepared:—

Shiraye kaolin	100grms.
Sodium sulphate	41 ..
Carbonate	11 ..
Charcoal	17 ..
Sulphur	13 ..
	212 ..

This gave on calcination a homogeneous green mass, which, after blueing, became a good ultramarine; but it was not so lustrous as the carbonate ultramarine before mentioned. The weight of the ultra-

	Gotô (A).	Gotô (B).	Gairone.	Harima.	Yamato.	Tororoishi.	Tonoguchi.	Shigaraki.	Shiraye.
SiO_2	48.85	48.42	53.90	65.49	62.41	71.53	76.78	58.42	47.74
Al_2O_3	36.89	37.09	41.95	28.31	24.73	16.75	17.02	28.37	36.68
Fe_2O_3 .....	.46	.50	1.25	.41	2.68	.75	.13	1.20	.42
CaO} .....	.40	.45	.56	.71	.49	1.65	.41	1.42	.99
MgO} .....	.15	.01	—	—	—	.17	.11	—	—
K_2O	6.80	6.13	1.78	.34	.54	1.88	—	2.53	.24
Na_2O} .....	.87	.83	.48	1.41	—	1.58	.36	2.65	.21
Loss on ignition ..	5.90	6.16	—	3.16	9.84	3.06	5.22	5.29	13.64
	100.34	99.89	99.92	99.88	100.69	100.36	100.33	99.88	100.03
Ratio of Al_2O_3 to SiO_2	1:2.25	1:2.22	1:2.2	1:3.9	1:4.29	1:7.12	1:7.67	1:3.55	1:2.25

amount of free silica was added to a given amount of the kaolin so as to make the ratio as 1:3, and the following carbonate mixture was prepared:—

Kaolin + silica	50grms.
Sodium carbonate	50 ..
Sulphur	30 ..
Charcoal	6 ..
	136 ..

Proceeding in the same way, the author obtained ultramarine of somewhat reddish shade, which could resist the action of weak acetic acid and a solution of alum better than the one prepared without any addition of silica. The yield of ultramarine, however, was very much less than in the previous case.

Next, experiments were made with a view to prepare sulphate-ultramarine with the kaolin to which a calculated amount of free silica was added so as to make the ratio of Al_2O_3 to SiO_2 as 1:3. The following mixtures were prepared:—

	I.	II.	III.
Kaolin + silica	100	100	100
Sodium sulphate	83	90	100
Charcoal	17	17	17

Proceeding in the usual way with these mixtures no ultramarine was obtained.

Instead of free silica, some kaolin, rich in silver, was then added to the Shiraye kaolin so as to make the ratio of the whole Al_2O_3 to SiO_2 as 1:3. For this purpose, calculated quantities of Tonoguchi and Shiraye kaolins were mixed intimately, and the carbonate mixture was then prepared in the usual proportions. The ultramarine obtained from this mixture was pretty good, and had a reddish shade. When, how-

marine thus obtained was about 25 per cent. of the original mixture.

After a few more experiments, using different proportions of materials, the author deduces the following summary:—

1. Of the Japanese kaolins which were subjected to experiments, Shiraye kaolin is the best, in which the ratio of Al_2O_3 to SiO_2 is 1:2.

2. Carbonate ultramarine prepared with this kaolin in Gentele's proportion is very bright, and has a deep blue colour.

3. Sulphate ultramarine made under the same conditions is inferior in lustre, and has a light blue colour.

4. The same kaolin, with the previous addition of silica or another clay, so as to make the ratio of Al_2O_3 to SiO_2 as 1:3, gives carbonate ultramarine of somewhat reddish shade, but no sulphate ultramarine.

5. Materials, when mixed to form two kinds of ultramarine, give a good product of intermediate shade, but it is not so bright as carbonate ultramarine.

Communication.

NOTE ON THE VOLUMETRIC TEST FOR MANGANESE.

BY R. W. ATKINSON, B.Sc., F.I.C.

I HAVE to thank Mr. Pattinson for calling attention, in the July number of this Journal, to the error in

of a system of small pipes is placed in direct communication with the diaphragm D, which acts upon the stem of a valve V inserted in the pipe H. If the water in vessel G sinks below a certain level, it exposes the chamber A to the heat of the steam, thereby expanding the liquid therein, which, acting upon D, closes the valve V, and thereby re-establishes the water level in G. If desired, a gauge C may be provided as shown for the purpose of externally indicating the action of the apparatus. Reference is made also to previous patents, 15,947 of 1884, and 303 of 1885, by the same inventor.—B.

Improvements in Filter-presses and in Apparatus connected therewith. J. B. Allott, Radford, Nottingham. Eng. Pat. 10,942, September 15, 1885. 11d.

The improvements herein specified are of two kinds—first, to provide a rapid means for drawing back the movable head of the filter-press, and, second, to provide means for preventing the fracture of the plates when operating upon fibrous substances, such as are met with in sewage sludge. A cylinder provided with a piston, and having a connection both for the inlet and outlet of air or steam at each of its ends, may be placed co-axially with the filter-press. When the tightening nuts and distance pieces used for forcing the chambers together are run back, the admission of steam to the cylinder or compressed air causes the follower to be rapidly drawn back. Another modification is shown where the air cylinder is placed below the filter-press, and operates upon the follower by means of a bell crank or bent lever. The fracture of the plates is prevented by staying their surfaces, and this is done by providing faced projections cast upon the plates themselves, or formed upon the collars securing the cloths in position and bearing against each other. The bearing stays may be also made loose, and screwed into the body of the plate through the cloth, and they then assist in maintaining the cloth in position.—C. C. H.

An Improved Mechanical Filter. A. P. Laurie, Dud-dingstone. Eng. Pat. 11,687, October 1, 1885. 8d.

THIS apparatus consists of a tank open or closed at the top, containing the material to be filtered, and at the bottom of which is placed the filtering medium, consisting of a sheet of felt secured between two perforated sheets of iron or steel. The bottom of the tank is connected by four pipes with a direct acting steam pump, which has two cylinders—one the water pump, and the other an air pump. The liquid is drawn through the filtering medium by the suction of the pump at one end of the tank, and coincident with this operation a current of air is forced through the filtering medium at the other end of the tank. Gas or steam may be used instead of the air, and the object of the inventor is to keep the filtering medium open and unclogged by the solid matter removed by the filtration. The patentee claims the general arrangement of combination of the different parts of the apparatus described and shown.—C. C. H.

II.—FUEL, GAS, AND LIGHT.

*Mineral Oil Lamps.** Sir Fredk. A. Abel and Mr. Boverton Redwood.

THE accidents which occur in the use of mineral oil lamps have formed the subject of an inquiry in which we have, for some time past, been engaged. Although the completion of this inquiry has been delayed by official calls upon us, it had progressed far enough a year ago to admit of our making certain practical suggestions, the chief of which were embodied in a circular issued last October and widely distributed by the Metropolitan Board of Works. A copy of this circular is enclosed. A large number of the accidents with mineral oil lamps are not actually due to the occurrence of explosions, but arise from fracture of the oil reservoir, caused by the lamp being dropped or upset, or carelessly

carried about, or by the burner becoming overheated. Many accidents have, however, doubtless resulted from the explosion of the mixture of petroleum vapour and air formed in the upper part of the oil reservoir. They usually occur after the lamp has been burning for some time, and when it is being moved, or is being extinguished by the process of "blowing down the chimney." Such explosions, even if not sufficiently violent to fracture the lamp, may so alarm the person carrying or handling it as to cause the lamp to be dropped or overturned. A careful investigation of many accidents, together with a critical examination of the construction of various lamps, and the results of many experiments, have led us to arrive at several definite conclusions with respect to the immediate causes of lamp explosions, and to certain circumstances which may tend to favour the production of such explosions, of which the following is a summary.

If the lamp of which the reservoir is only partly full of oil be carried or rapidly moved from one place to another so as to agitate the liquid, a mixture of vapour and air may make its escape from the lamp in close vicinity to the flame, and, by becoming ignited, determine the explosion of the mixture existing in the reservoir. This escape may occur through the burner itself if the wick does not fit the holder properly, or through openings which exist in some lamps in the metal work close to the burner of sufficient size to allow flame to pass them readily. A sudden cooling of the lamp by its exposure to a draught or by being blown upon may give rise to an inrush of air, thereby increasing the explosive properties of the mixture of vapour with a little air contained in the reservoir, and the flame of the lamp may at the same time be drawn or forced into the air-space filled with that mixture, especially if the flame has been turned down, as the latter is thereby brought nearer to the reservoir. The sudden cooling of the glass, if it had become heated by the burning of the lamp, may also cause it to crack if it is not well annealed, and this cracking, or fracture, which may allow the oil to escape, may convey the idea that an explosion has taken place. If the evidently common practice is resorted to of blowing down the chimney with a view to extinguish the lamp, the effects above indicated as producible by a sudden cooling may be combined with the sudden forcing of the flame into the air-space, and an explosion is thus pretty certain to ensue, especially if that air-space is considerable. If the flashing point of the oil used be below the minimum (73° Abel) fixed by law, and even if it be about that point or a little above it, vapour will be given off comparatively freely if the oil in the lamp be agitated, by carrying the latter, or moving it carelessly; the escape of a mixture of vapour with a little air from the lamp, and its ignition, will take place more readily, but, on the other hand, it will probably be feebly explosive, because the air will have been expelled in great measure by the generation of the petroleum vapour. If the flashing point of the oil be high, the vapour will be less readily or copiously produced under the conditions above indicated; but as a natural consequence, the mixture of vapour and air existing in the lamp may be more violently explosive, because the proportion of the former to the latter is likely to be lower and nearer that demanded for the production of a powerfully explosive mixture.

If the quantity of oil in the lamp reservoir be but small, and the air space consequently large, the ignition of an explosive mixture produced within the lamp will obviously exert more violent effects than if there be only space for a small quantity of vapour and air, because of the lamp being comparatively full. If the wick be lowered very much, or if for some other reason the flame becomes very low, so that it is burning beneath the metal work which surrounds and projects over the wick holder, the lamp will become much heated at those parts, and the tendency to the production of an explosive mixture within the space of the lamp will be increased, while at the same time, heat will be transmitted to the glass, and it will be correspondingly more susceptible to the effects described as being exerted by its sudden exposure to a draught. Experi-

* The substance of a letter to the *Daily News* of September 22nd, 1886.

ments have demonstrated that a lamp containing an oil of high flashing point is more liable to become heated than if it contained a comparatively light and volatile oil, in consequence of the much higher temperature developed by the combustion, and of the comparative slowness with which the heavy oil is conveyed by the wick to the flame. Safety in the use of mineral oil lamps is therefore not to be secured simply by the employment of oils of very high flashing point (or low volatility), and the use of very heavy oils may even give rise to dangers which are small, if not entirely absent, with oils of comparatively low flashing points.

The character of the wick materially affects not only the burning quality of the lamp, but also its safety. A loosely-plaited wick of long staple cotton draws up the oil to the flame regularly and freely, and so long as the oil be not very heavy or of very high flashing point, and therefore difficultly volatisable or convertible into vapour, the flame will continue to burn brightly and uniformly, and with but little charring effect upon the wick. But if the wick be very tightly plaited and made of a short staple cotton of inferior capillary power, the oil will be less copiously drawn up to the flame. As a consequence, the length of exposed wick will be increased by the user of the lamp, and as the evaporation of the oil will take place more slowly from each portion of the wick which furnishes the flame, the heat to which the cotton is exposed will be greater, and the charring, which is fatal to the proper feeding of the flame by destroying the porosity of the end of the wick, will take place more rapidly and to a much greater extent. If the wick be at all damp when taken into use its power of conveying the oil to the flame will be decidedly diminished, the capillaries of the fibre being more or less filled with moisture, and similarly, if the oil accidentally contain any water, the latter, passing into the wick, will interfere with the proper feeding of the flame. As the oil is very thoroughly filtered or strained during its transmission through the body of the wick to the flame, it is obvious that any impurities suspended in the liquid will be deposited within the wick, and will gradually diminish its porosity. For this reason the same wick should not be used for a great length of time, and it is decidedly objectionable to use a much greater length of wick than is necessary to reach to the bottom of the reservoir, and to continue its use until it has become too greatly shortened by successive trimmings.

It follows therefore that it is undesirable to construct the lamp reservoir of the fragile materials commonly employed; that channels of communication to the reservoir at or near the burner should be protected by fine wire gauze (twenty-eight meshes to the inch), or be packed with wire, or should not be of a greater diameter than 0.04 inch; and that the wick tube should be prolonged so that the lower end is always sealed by the oil, or the wick surrounded by a wire gauze cylinder of the requisite fineness, and closed at the bottom, which would allow the passage of air or vapour through it towards the burner, while it would effectually prevent the transmission of fire from the lamp flame to the air-space of the reservoir. Lamps are now sold to which these safety expedients have been applied.

These remarks may tend to dispel groundless alarm as to the dangerous nature of petroleum—and paraffin—oil as illuminants, and may, on the other hand, serve to convey some useful information respecting the causes which lead to accidents with lamps, and the readiness with which such accidents may be avoided.

The following is the circular referred to above:—

METROPOLITAN BOARD OF WORKS,
SPRING GARDENS, S.W., OCTOBER, 1885.

PETROLEUM ACTS.

In view of the numerous fatal and other accidents caused by petroleum lamps, the Board consider it desirable to make public the following suggestions as to the construction and management of such lamps, which are founded on recommendations made by Sir Frederick Abel, C.B., D.C.L., F.R.S.,

and Mr. Boverton Redwood, F.I.C., F.C.S., Chemist of the Petroleum Association, after investigating the causes of lamp accidents.

SUGGESTIONS AS TO THE CONSTRUCTION AND MANAGEMENT OF PETROLEUM (OR PARAFFIN) LAMPS.

CONSTRUCTION OF LAMPS.

1. That portion of the wick which is in the oil reservoir should be enclosed in a tube of thin sheet metal, open at the bottom; or in a cylinder of fine wire gauze, such as is used in miners' safety lamps (28 meshes to 1 inch).
2. The oil reservoir should be of metal, rather than of china or glass.
3. The oil reservoir should have no feeding place nor opening other than the opening into which the upper part of the lamp is screwed.
4. Every lamp should have a proper extinguishing apparatus.
5. Every lamp should have a broad and heavy base.

WICKS.

6. Wicks should be soft, and not tightly plaited.
7. Wicks should be dried at the fire before being put into lamps.
8. Wicks should be only just long enough to reach the bottom of the oil reservoir.
9. Wicks should be so wide that they quite fill the wick-holder without having to be squeezed into it.
10. Wicks should be soaked with oil before being lit.

MANAGEMENT.

11. The reservoir should be quite filled with oil every time before using the lamp.
12. The lamp should be kept thoroughly clean, all oil should be carefully wiped off, and all charred wick and dirt removed before lighting.
13. When the lamp is lit, the wick should be at first turned down, and then slowly raised.
14. Lamps which have no extinguishing apparatus should be put out as follows:—The wick should be turned down until there is only a small flickering flame, and a sharp puff of breath should then be sent across the top of the chimney, but not down it.
15. Cans or bottles used for oil should be free from water and dirt, and should be kept thoroughly closed.

J. E. WAKEFIELD,

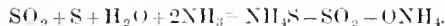
Clerk of the Board.

NOTE.—The suggestions apply to ordinary mineral oil lamps such as are generally used, and not to benzoline or spirit lamps.

The Formation of Ammonium Thiosulphate in Gas Generators. H. Endeman. Amer. Chem. Soc. Journ. 8, 47.

THE author has observed the occurrence of ammonium thiosulphate as a condensation product from a gas generator in which air forced through anthracite coal was converted into a mixture of carbon monoxide and nitrogen, which was to be used for metallurgical operations. As a Körting steam blower was used for the blast, a certain amount of steam entered with the air, and the steam being wet, the under part of the generator was soon blown cold, and the heat developed only in the upper parts. The gases produced passed from the generator through a 30-inch main, and thence through branches to places where the gas was to be utilised, and in the main pipe, as well as in the branches, considerable quantities of liquid condensed, and were drawn off from time to time, and it was observed that where the liquid had a chance of passing through joints, there were formed long stalactites of a pinkish colour, and proving, on examination, to consist mainly of ammonium thiosulphate. The sulphur was evidently derived from the anthracite coal, the nitrogen of the ammonium radicle from the atmospheric air, and the hydrogen from the steam. The author explains the progress of the reaction to be as follows:—The upright generators contain layers of anthracite in different stages of combustion, the lower, hottest layer of coal producing carbon dioxide, which is reduced to the monoxide in the upper layers. The pyrites present in the anthracite is first split up by heat into sulphur and ferrous sulphide. The sulphur passes off with the gaseous products, and the ferrous sulphide in its downward course through the furnace meets with free oxygen, and yields oxide of iron and sulphur dioxide, which latter passes on likewise with the gases. Some of the water is decomposed by the carbon of the anthracite, yielding free hydrogen, a portion of which is found as such in the gaseous products, whilst a further portion

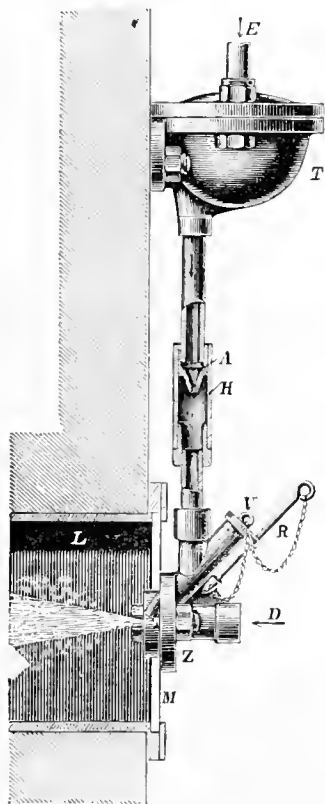
reacts with atmospheric nitrogen to form ammonia. In this way the gaseous products—namely, carbon, hydrogen and nitrogen—are accompanied into the main with a number of condensable substances, amongst which are water, sulphur, sulphur dioxide and ammonia. When condensation takes place, the following reaction occurs:—



That this is a correct expression, may be adduced the well-known fact that alkaline sulphites in solution have the power of dissolving sulphur to form thiosulphates. The formation of ammonia from nitrogen and hydrogen at high temperatures is already conceded, and since in the present case the hydrogen would be in the nascent state, it might be expected to combine more readily with the nitrogen than it has been observed to do in experiments with a mixture of gases. Moreover, the formation of ammonia during the combustion of non-nitrogenous substances in air is also an established fact. Since the above observations were made, the generator has been fitted with an ordinary fan-blast in place of the steam-blast, and the formation of ammonium thiosulphate now no longer takes place.—W. D. B.

A Steam-spray Apparatus for Tar and Inflammable Oils. Chem. Zeit. 10, 676.

THIS apparatus, constructed by Messrs. Korting Brothers in Hanover, consists of a tube from which the tar, which runs in at the top, flows out in a thin stream in the front, where it meets a jet of steam, and is thereby formed into a spray. The peculiar manner in which the steam jet is constructed prevents even the smallest quantity of tar from falling down unburnt. It contains



the sieve which retains impurities in the tar. The sieve may be readily removed and cleansed. A is a nozzle, which regulates the flow of tar. The jacket H may be lowered in case the nozzle gets choked. V may also be cleaned out with the rod R when required. The steam-spray apparatus Z is fixed in the furnace wall, and by means of the steam jet, which passes through D,

sufficient air for combustion is admitted into the hearth. To regulate the combustion a valve is attached to the jet, also a damper M, for the admission of air. The tar is placed in a vessel above the retort furnace where the heat keeps it liquid.—J. B. C.

A Mixture of Coke and Tar as a Fuel for Gas Generators. W. Bäcker. Journ. f. Gasbel. und Wasservers. 29, 338.

THE author states that 40 per cent. of the tar produced may be economically employed as a fuel. It is run in under the coke about 40cm. below the surface, a little steam being introduced with it to prevent the stoppage of the pipe by the ignition of the tar at its mouth. The cost of the plant is said to be small. One kilo. of tar may be added to four kilos. of coke.—S. Y.

Improved Means and Substances for Producing an Explosive Agent, and the Employment thereof for the Working of Engines for Power Purposes. J. Graddon and P. Harding, Catford. Eng. Pat. 11,215, Sept. 21, 1885. 6d.

THE inventors propose the employment of phosphoretted hydrogen as an agent for igniting the mixture of hydrocarbons and air in gas-engines.—S. H.

A Process and Apparatus for Manufacturing Water Oil Gas. O. Inray, London. From J. B. Areher, Washington, U.S.A. Eng. Pat. 6349, May 11, 1886. 6d.

STEAM superheated to about 1000° F. is made to pass through an injector and draw with it a quantity of oil, which becomes mixed with it; the mixture is further heated to about 1300° F., and then receives in admixture with it an additional quantity of oil, and finally this mixture is heated to about 2400° F., whereby it is converted into permanent gas suitable for heating or illumination. The apparatus used consists of three concentric cylindrical casings standing vertically with their pipe connections as follows: The outermost casing is a cylindrical shell of metal in two parts, the lower one a superheater, having within it a helical passage along which steam, led by a pipe from a boiler, is made to pass in order to become superheated, and the upper part or final retort having an internal space in which the gaseous mixture undergoes its final heating. The outermost casing is enclosed in brickwork. The second casing is of metal not extending so high as the outermost casing, and separated from it by an annular flue space. Within the second casing and separated from it by an annular flue space, is the primary retort—a vertical cylinder closed at the bottom, and expanding at the top to give an enlarged space closed by a removable cover. Below the bottom of the primary retort is a gas burner consisting of a circle of jets, directly heating the bottom. Briefly, the pieces of apparatus required may be enumerated as the burner, the steam superheater and injector, the retort with its internal shell and pipe, the mixing vessel, the helical retort and the final retort with their connecting pipes, and regulating cocks or valves.—W. S.

Improvements in Apparatus for Heating Solid Substances out of contact with the Products of the Combustion of the Fuel employed. Walter F. R. Weldon, Burstow. From A. R. Peckiney & Co., Salindres. Eng. Pat. 9225, May 31, 1886. 1s. 3d.

PATENT 9304, of June 23, 1884, describes a method and apparatus for heating solid substances in brickwork chambers or receptacles by previously passing flame and hot products of combustion through a series of the said chambers in succession, till so much heat is absorbed and stored up in the brickwork that the products of combustion may be cut off, and the charge, being introduced, be heated as required. According to the present invention, which is an improvement on the foregoing,

each heating chamber communicates directly with the combustion chamber, and the products of combustion, after leaving the heating chamber, are brought back to the burner to heat the air and gas employed there. The burner is movable, and provided with wheels, so that it may be applied to whichever chamber is to be heated up. The specification is accompanied by full drawings.

—A. R. D.

Meizel and Couffinhale's Gasholder. Dingl. Polyt. J. 261, 126—128.

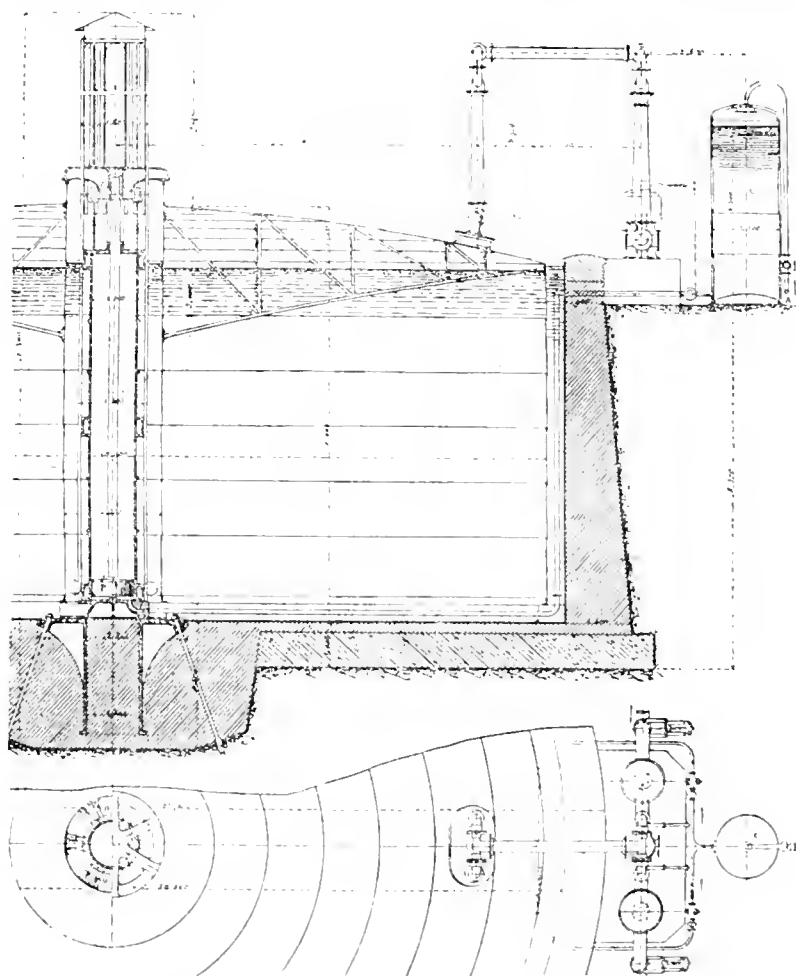
THE novel feature of this apparatus consists in the employment of hydraulic pressure for balancing the receiver. The latter is by means of the star-shaped frame G, attached to the rod of a piston P, which moves in a long cylinder fixed in the centre of the apparatus and resting on a firm foundation. The frame G also serves for the suspension of a number of rollers, which glide on rails fixed to the cylinder. The latter stands in communication with the vessel C. By the direct pressure of steam (entering by A) the water contained in C is forced into the cylinder and causes the piston and with

than in the case of the old system, and a considerable saving is effected in the plant of a gas-works by the adoption of the arrangement described. The makers of this apparatus are the Société des Forges et Ateliers de la Chalassière, V. Biétrex & Co.—F. M.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

The Petroleum Oil of Baku. C. Engler. Dingl. Polyt. J. 260, 337—353, 433—445, 481—488, and 525—535.

ALTHOUGH a mass of information has already been published on the Russian petroleum industry, and Marvin and Redwood have by their comparatively recent contributions (see *Engineering*, 1884, 171; and this Journal, 1885, 70) almost exhausted the whole of this subject, the author, who visited Baku and its surroundings in the autumn of last year, considered it of sufficient importance to give a supplementary series of sketches of this industry, bringing its record nearly down to the end of 1885. His remarks are divided



it the receiver to rise. A pressure governor regulates the supply of water to the cylinder in such a manner that the speed with which the receiver rises is always in ratio to the amount of gas supplied by the retorts. By the action of a second governor, which controls a valve allowing the water to return to C, the pressure of the gas drawn from the receiver is being kept constant. Exhausters for diminishing the pressure in the retorts are unnecessary where this apparatus is adopted. The cost of working is said to be less, or at least not greater

under the following heads: (1) Historical and statistical accounts; (2) Occurrence, production, collection and transportation of the crude petroleum; (3) Refining; (4) Manufacture of lubricating oil; and (5) Transportation of the products of Baku. As the papers contributed by Marvin and Redwood deal minutely with the subjects under the first and second heads, it is proposed not to discuss them again. The refining of the crude oil is carried on almost exclusively in the so-called Black Town (*Tcherni Gorod*) at Baku, where,

out of a total of 136 refineries, 100 were in operation at the end of 1885. The most important refiners are :—

	Plant capable of producing annually
Nobel Brothers	216,300 tons of kerosene.
Caspian Company	41,400 ..
Pallaschkowsky (Batoum Naphtha Co.) ..	11,100 ..
Tagieff and Sarkisoff (at Bibieybat) ..	32,500 ..
Baku Naphtha Company (Suvakhani) ..	21,600 ..
Schibajeff (formerly V. J. Ragosine) ..	16,700 ..

The crude oil from Balakhani and Sabuntschi, which is refined in the Black Town, has an average sp. gr. of 0·865—0·870, whilst the oil refined at Bibieybat has a sp. gr. of 0·855—0·858. The products of distillation differ with the sp. gr., as is shown in the following table :—

	Balakhani-Sabuntschi.	Bibieybat.
Light petroleum	5—6 per cent.	10·5 per cent.
Burning oil I. (kerosene) ..	27—33 ..	40·0 ..
Burning oil II. (solar oil) ..	5—6 ..	13·5 ..
Residues	50—60 ..	36·0 ..

The distillation of the crude petroleum for the purpose of separating the kerosene therefrom is effected in apparatus of three different forms: (1.) Stationary,

Its ends rest on iron rails *a*, and the sides are supported by angle irons set into the brickwork. *B* is a dome, and *c* the outlet communicating with a pipe leading to the condenser. *C* is the space in which the residues are burnt, the flames returning by way of *C*₁ and *C*₂. The stills are mostly worked in groups or series. *N* is a charging main with branches *n*, and *d* a steam main with branches *d*₁ running along the back of the stills. The residues are discharged at *E*. *m* is a manhole for cleaning purposes. A dephlegmator or separator is frequently placed between the head of the still and the condenser to separate and return to the still any high boiling oils carried over mechanically. Fig. 5 represents a dephlegmator of simple construction. In Figs. 6 and 7, *a* is an iron cylinder, surrounded by a jacket *b*, and divided in two parts by *c*. The vapours enter at *d*, pass through the apparatus in the direction indicated by the arrow, and escape at *d*₁. The oil which accumulates at the bottom of the cylinder is removed by means of a special pipe. For condensing purposes, cooling worms of the usual construction, or cast-iron pipes of the form shown in diagrams 8 and 9, are employed. Four pipes are placed parallel to one another in a horizontal

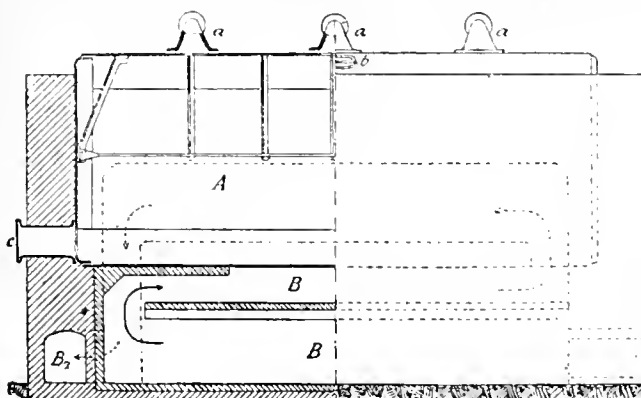


FIG. 1.

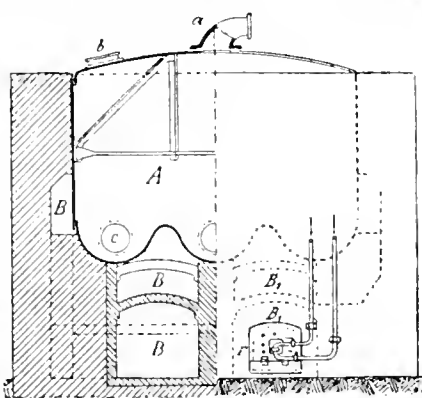


FIG. 2.

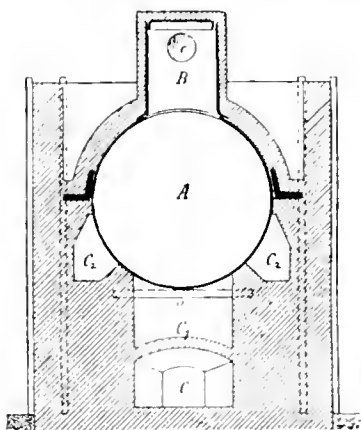


FIG. 3.

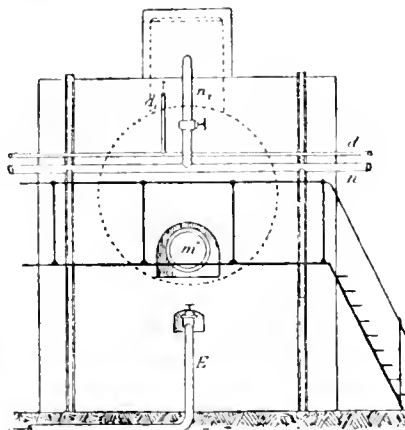


FIG. 4.

wrought-iron cylindrical stills, with convex bottom and the ordinary construction of still head, heated by petroleum residues. These stills are almost out of use at the present time. (2.) Waggon boilers (see Figs. 1 and 2), made of wrought-iron plates. Dimensions, 7 metres by 4 by 3. *A* is the still, with corrugated bottom and three still heads *a*. *b* is a manhole, and *c* the outlet for the residues. *B*, *B*₁, and *B*₂ represent the brickwork and the arrangement of the flues. *v* is the "residues" burner. This apparatus is capable of refining from 7 to 8 tons of crude petroleum in 24 hours. (3.) Cylindrical wrought-iron stills, illustrated in Figs. 3 and 4. The still *A* is 5—6m. long, and has a diameter of 2—3m.

position, and in sets of six, one above the other, so that the entire system consists of 24 pipes. The vapours which enter at *a*, are distributed in the head-piece *b*, and pass from the uppermost set of pipes to the lowest series, meeting at *b*₁, *b*₂, and *b*₃, and so on until *b*₁₁ is reached, from whence the condensed oil flows into the receiver. The distillate is collected in closed vessels, the separation of the water from the oil being effected in apparatus similar in principle to a Florence flask. An arrangement of this kind, which admits of the simultaneous observation of the colour of the distilled product, is represented in Fig. 10. The oil after leaving the condenser at *a* runs into the receiver *A*.

The water is removed through the pipe *b*, the undecomposable gases escape at *c*, whilst the oil flows over into *d*, and from thence passes through the lantern B to the different receiving vessels by way of pipes 1 to 5.

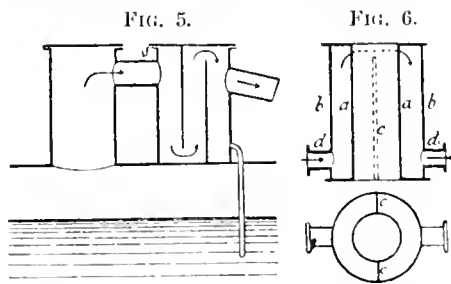


FIG. 7.

The residues, called *astutki* by the Russians, and *masut* by the Tartars, which are obtained in the refining of crude petroleum, are mainly used for heating purposes, their fuel value being almost double the value of ordinary coal. With burners of ordinary construction, 1 kilo. of residues evaporates about 12 kilos. of water, whilst with

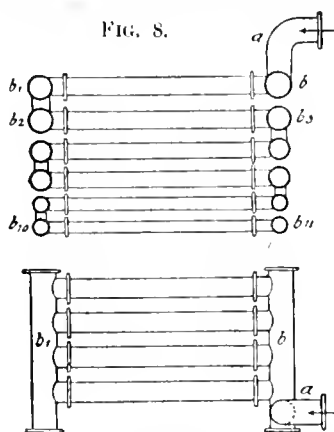


FIG. 9.

special burners it is possible to evaporate from 14 to 15 kilos. To refine 100 parts of crude petroleum, from 3 to 4 parts of residues are required. The principle of the ordinary oil burner (see Figs. 11 to 14) consists essentially of an arrangement for spraying the oil by means of a jet of steam, the size and form of the flame

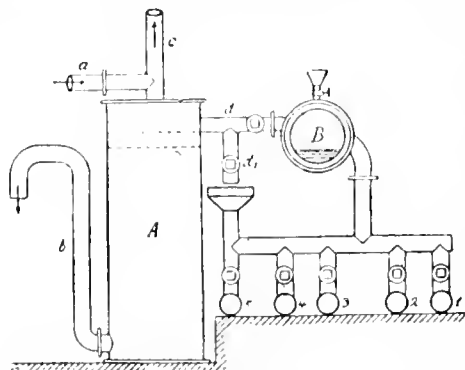


FIG. 10.

depending on the construction of the pipe D. A burner frequently employed is that known by the name of the Brandt system (Fig. 15). N is the inlet for the residues, and D that for the steam. Both meet between *f* and *i*, which can be adjusted, and project a tongue of flame

into the furnace at *s*. When the burner is in use, the valves *o* and *l* are opened completely, the pressure of steam and flow of residues being regulated by adjusting the cone *f*. The application of this burner to a Cornish steam boiler is represented in Figs. 16 and 17. R is a store tank, and N a pipe which supplies the oil. D is the steam pipe. The air necessary to support the combustion is introduced through holes in the furnace door *t*. Diagrams 18 to 20 illustrate the oil burner devised by Lenz. D and N are the inlet pipes for steam and residues communicating with the tubes *a* any *a*₁. *g* is a mixing chamber, closed at the top and bottom by screw covers *h*. *o* are rods fitted with eccentric terminals working the slides *c* (see Fig. 19). This arrangement serves to regulate the flow of steam and residues. The mouthpiece *s* is a horizontal fissure running round one half of the cylindrical chamber *g*. The burner consumes from 3 to 3.5 kilos. of residues (sp. gr. = 0.91, flashing point = 140°) per hour per horse power. Nobel Brothers employ the Sandgreen burner (see Fig. 21). Oil and steam are introduced through N and D into the chamber A B, which is divided by the partition *f*. The burner is regulated by the plate *k*, which can be adjusted by the lever *h* and bar *l*. The plate *k*, which forms the

FIG. 11.

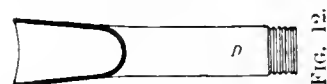
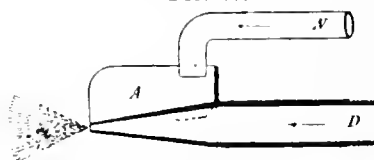


FIG. 12.

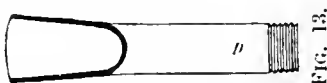


FIG. 13.

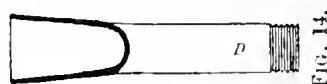


FIG. 14.

outlet for the steam, does not admit of adjustment. By withdrawing the plug *m* steam may be passed through *g* into the oil chamber A for cleaning purposes. For locomotives or tubular boilers it is necessary to employ a burner capable of dispersing the flame over a large surface. Figs. 22 to 25 represent an improved Lenz burner suitable for this purpose. It is similar in construction to the above burner (Fig. 20), the only difference being that the mouthpiece *s* runs round the whole of the cylindrical chamber *g*. By this modification the flame of oil projected into the furnace, instead of being pointed, is made to assume the shape of a ring, and consequently the effect upon the plates of the boiler is less prejudicial. The alteration in the construction of the mouthpiece *s* necessitates a modification in the form of the slides *c* and *c*₁, which in this case are cylindrical, their mode of working being shown in Fig. 24. Fig. 25 is a vertical section through diagram 23 at D and N, which are the steam and oil inlets. In order to clean the oil chamber, steam is introduced through the valve *h*. Fig. 22 illustrates a further modification in the construction of the mouthpiece of the burner. Diagrams 26 and 27 represent an oil burner devised by Brandt, suitable for locomotives. The horizontal disc *a* divides the chamber of the burner into two parts, steam being introduced into the lower part at D and the residues into the upper part at N. The openings at *i* are regulated by the disc *o*, a slight revolution of which either increases or diminishes the width of the apertures. *f* is the mouth of the burner. Fig. 28 shows the same burner *l* in the fire-box of a locomotive. The burner is placed in the centre of the hearth *k*. The residues and steam are introduced through pipes N and D, provided with the valves

4. To work a train with twenty loaded trucks about 10 kilos. of residues are required for each kilometer.

Before retining, the crude petroleum is settled in iron tanks for several days. It is then passed through pipes contained in the vessels in which the residues obtained in the process of distillation are cooled. By this means the oil is heated to a temperature varying between 80°

lined with lead. The mixture of oil and acid is agitated by the introduction of compressed air into the bottom of the washing vessel. The oil is washed with acid in two operations, the waste acid from a previous purification being used for the first treatment, and fresh acid for the second washing, the quantity of acid employed being from 0.6 to 0.9 per cent. After the removal of the last

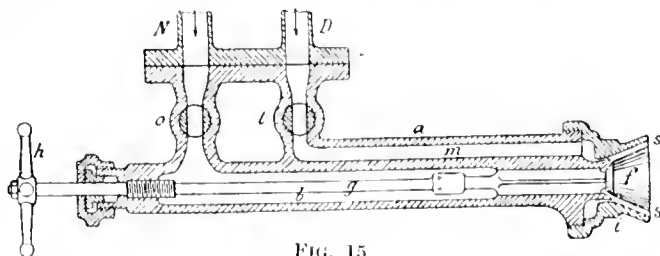


FIG. 15.

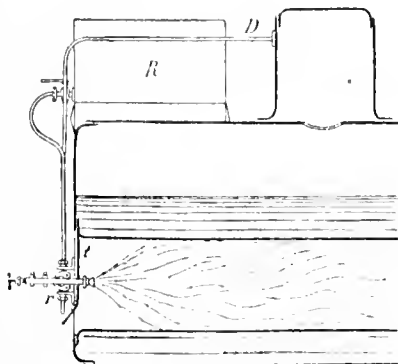


FIG. 16.

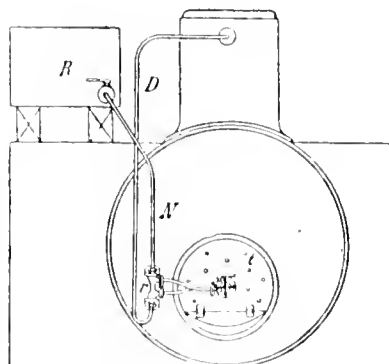


FIG. 17.

FIG. 19.

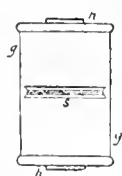
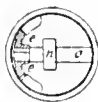


FIG. 18.

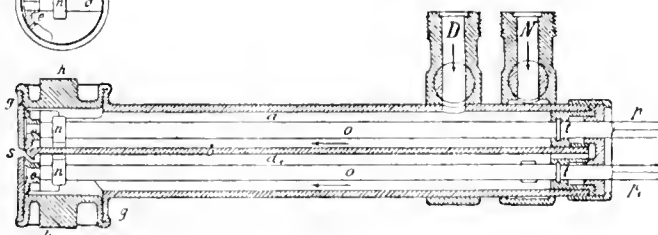


FIG. 20.

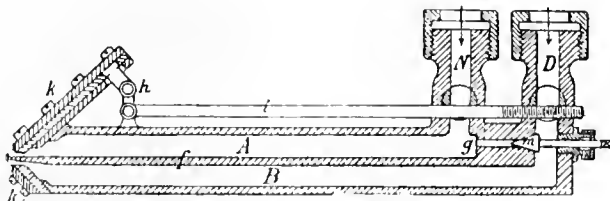


FIG. 21.

and 130°, and may be transferred to the hot stills almost immediately after the withdrawal of the residues. To facilitate the distillation, superheated steam is introduced into the still. The purification of the kerosene is effected in iron cylindrical vessels having a conically-shaped bottom and holding from 100 to 200 tons of oil. Two such vessels are placed alongside each other, one above the other. The washing with acid is effected in the upper vessel, which for this purpose is

acid the oil is washed with cold water. It is then run into the lower vessel and agitated with a solution of caustic soda, having a sp. gr. of 1.28—1.35. This treatment is repeated with a less concentrated solution of alkali, the total amount used depending upon the quantity of acid contained in the oil; with careful work it does not exceed 0.3 per cent. of Na O. It is best not to wash the oil with water after the treatment with alkali, as, owing to the decomposition of traces of soda soaps in

solution, the oil may assume an opacity which cannot be subsequently removed without difficulty.

For the examination of the refined kerosene the following tests are in vogue: The presence of organic acids is determined by agitating the oil with about 2 per cent. of a solution of caustic soda, having a sp. gr. of 1.2 and

of the oil is effected by employing Stammer's instrument (see Redwood, this Journal, 1885, 77). Good kerosene should be colourless and water-clear. To test the oil photometrically, Bunsen's apparatus is used, the height of the flame of the standard candle being 52mm. The distillation test is made with the aid of Glinsky's frac-

FIG. 22.

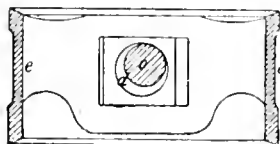
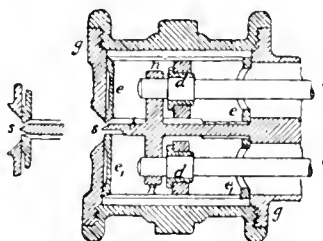


FIG. 24.

acidifying the alkaline solution after settling. The intensity of the milkiness produced forms the criterion of the amount of organic acid present in the oil. To ascertain whether the oil has been perfectly washed with

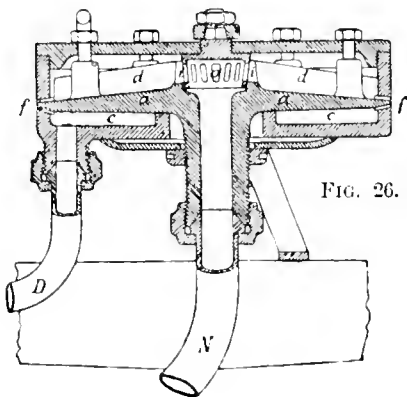


FIG. 26.

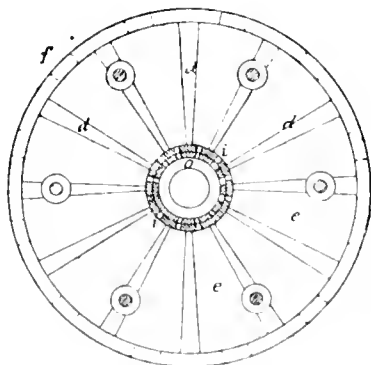


FIG. 27.

sulphuric acid it is again agitated with a small quantity of alkali. The formation of a white emulsion indicates sufficient washing; if, however, the emulsion assumes a yellow appearance, it shows that the oil has been insufficiently treated with acid. The colorimetric examination

FIG. 23.

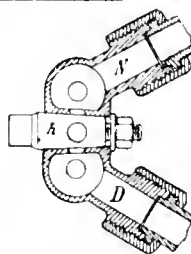
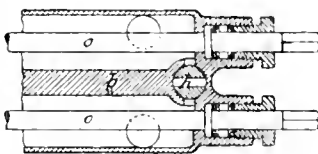


FIG. 25.

tionating apparatus, the distilling flask being filled with 250cc. of oil, and the distillation being completed in about two hours. The flashing point is mostly determined according to Abel's test. For Russia the flashing point

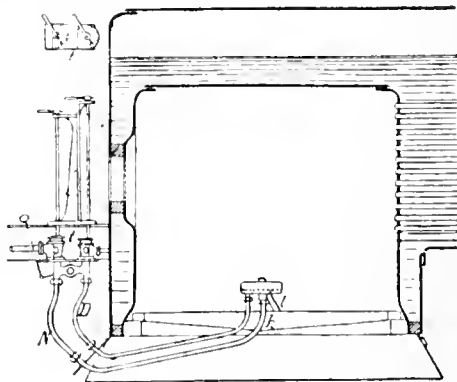


FIG. 28.

of kerosene, which has hitherto been 28–30°, has recently been reduced to 25°.

In discussing the manufacture of lubricating oils from the petroleum residues, the author refers to the paper by

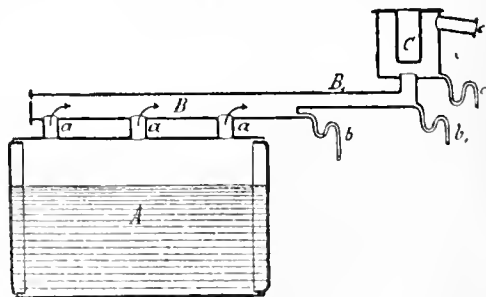


FIG. 29.

Ljutyk which appeared in *Dingl. Polyt. J.* 253, 460 (see this Journal, 1885, 111). The residues obtained by the

rectification of the crude petroleum at Baku represent a thin liquid oil having a sp. gr. of 0.90–0.91. Being almost free from paraffin they are well adapted for the manufacture of lubricating oils, nevertheless only 10 per cent. of the total quantity produced (56 per cent. of the crude oil) is utilised for this purpose, the remainder being employed as fuel. The manufacture of lubricating oil

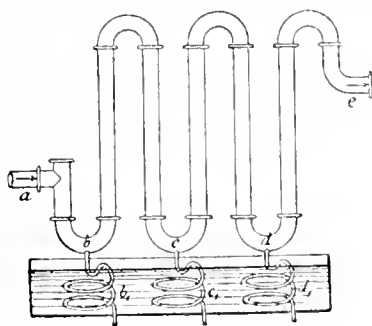


FIG. 30.

involves the re-distillation of the residues and purification of the product. The distillation is effected in horizontal wrought-iron stills, similar in construction to the stills used for refining the crude oil. In Fig. 29 A represents the still, which is 3.5m. long, 1.3m. deep and 2m. wide; *a* are upright tubes conveying the vapours to B, thence to the smaller pipe B₁, and through the "separator" C, and the pipe *c* to the condenser. The oil condensed in B runs away through the pipe *b*, that in

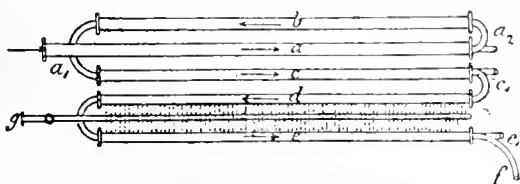


FIG. 31.

B₁ through *b*₁, and that in C through *c*₁. For cooling purposes condensers of the usual construction are employed. An effective air-cooling arrangement is shown in Fig. 30. The vapours enter at *a*, and pass through the series of bent pipes, which allow of the withdrawal of any condensed oils by the branches *b*, *c* and *d*. These communicate with the coils *b*₁, *c*₁, and *d*₁, which pass through a water-cooling apparatus. Fig. 31 represents an air-cooling system of recent origin. It consists of horizontal iron

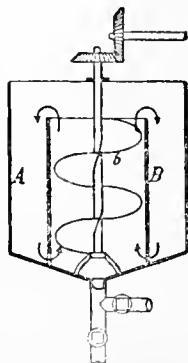


FIG. 32.

tubes *a* to *c*, which are 6 to 7m. long. The diameter of the tubes, which is about 20cm. in *a*, is gradually reduced to about 10cm. in the last tube *c*. The vapours enter the system at *a*₁, any oil condensed in *a* being withdrawn at *a*₂. The oils condensed in *b* and *c* run away at *b*₁ and those collected in *d* and *e* are removed through the pipe

e; from *e* the vapours pass through *f* and thence to the condenser. In *a*, *b*, and *c* the cooling is effected by air, and in *d* and *e* by both air and water. As fuel petroleum residues are employed, the distillation being assisted at the end by the introduction of superheated steam the temperature of which should not exceed 300°. The consumption of residues amounts to 20 per cent. of the charge employed. The distillate is generally fractionated in the following manner:—

	Per Cent.	Sp. Gr.
First runnings (solar oil)	10–15	0.870
Spindle oil ..	9	0.896
Engine oil.....	40–42	0.911
Cylinder oil	3–4	0.915

At a large refinery the following products are obtained:—

	Per Cent.	Sp. Gr.
Solar oil.....	10	—
Spindle oil	10	0.897
Engine oil	25	0.908–0.910
Cylinder oil	3	0.915–0.918

The purification of the lubricating oil with sulphuric acid and alkali is effected in iron pots A (Fig. 32) lined with lead. B is a cylindrical frame to which the stirrers *b* are attached. These agitate the mixture in the manner indicated by the arrows in the diagram. The oil is treated with 2 to 3 per cent. of concentrated sulphuric acid at 30°; the waste acid is then withdrawn and the oil agitated with a concentrated solution of caustic soda (20 B.), this treatment being repeated several times with a less concentrated solution after every washing. Finally the oil is washed with water, and dehydrated in shallow pans heated by the aid of steam coils. The author concludes his paper with some remarks relating to the cost and latest modes of transporting the different products manufactured at Baku.—D. B.

*Comparison between Caucasian and American Petroleum.** C. Engler and I. Levin. Dingl. Polyt. J. 261, 29–34.

THE question as to the illuminating value of petroleum oils of different origin, if burned under the most favourable circumstances, is still unanswered. Although there are to be found in technical journals experiments in that direction, the different specimens of oils were examined promiscuously, just as they occurred in the trade, without regard whether they represented the general average of the products of the Caucasian or American petroleum industry. Other investigators examined quite arbitrarily different fractions of an oil, burning them in the same lamp, and not taking into consideration that different fractions require a different construction of the lamp as regards the quality of the wick, the admission of air, and so forth. Photometric tests give, of course, the most trustworthy criterion as to the value of an oil; but, to answer the question fully, an examination of the different fractions, their capillarity, their rapidity of rising in the wick, and their viscosity is equally necessary. It is well known that petroleum-naphtha has a greater illuminating effect than the high-boiling oils; but, on the other hand, a high percentage of naphtha lowers the flashing-point, thereby increasing the probability of explosions. The regulations of the law give a guarantee against the flashing-test being too low, but the amount of high boiling oils

* See also Journ. Soc. Chem. Ind. 1886, 371.

TABLE I.

CRUDE PETROLEUM OIL, from—	cc. or grs.	Specific gravity at 150°.	Commencing to Boil at—	Up to 150°.	130—150°.	150—170°.	170—190°.	190—210°.	210—230°.	230—250°.	250—270°.	270—290°.	290—300°.	Up to 150°.	150—300°.	Above 300°.
Pennsylvania I.	cc. gr.	0.8175	82°	15.0	6.0	5.0	5.0	5.0	5.75	4.75	6.0	1.75	2.0	21.0	38.25	10.75
Pennsylvania II.	cc. gr.	0.8010	74	21.5	7.0	4.5	4.5	6.5	5.0	4.75	3.25	4.0	2.5	31.5	35.0	33.5
Galicia (Sloboda)	cc. gr.	0.8235	90	16.0	10.5	10.25	6.5	6.5	7.0	6.75	6.0	3.5	0.5	26.5	47.0	26.5
Baku (Bibeybat)	cc. gr.	0.8590	91	16.0	7.0	6.5	0.5	5.0	5.0	5.0	5.5	3.5	1.0	23.0	38.0	39.0
Baku (Balakhani)	cc. gr.	0.8710	105	3.75	4.75	5.5	4.75	5.25	5.0	7.0	4.75	5.5	1.75	8.5	39.5	52.0
Alsace (Pechelbronn)	cc. gr.	0.9075	135	—	3.0	4.1	5.1	4.5	6.6	7.3	7.0	10.3	1.5	3.0	50.0	17.0
Hanover (Oelheim)	cc. gr.	0.8600	170	—	—	—	4.75	5.25	6.0	4.0	5.0	5.0	2.0	—	32.0	68.0
							3.2	2.6	4.8	3.4	4.3	4.3	1.8		24.1	

SPECIMEN OF OIL.	No.	cc. or grms.	Flushing Test.	Specific Gravity.	Com- mencing to Boil at—	TEMPERATURE															
						Up to 130°	130—150°	150—170°	170—190°	190—210°	210—230°	230—250°	250—270°	270—290°	290—310°	Up to 310°	Above 320°				
CAUCASIAN REFINED PETROLEUM.	1.	cc. gr.	31°	0.820	129°	—	6.0	16.0	16.0	16.25	11.75	13.0	8.5	4.5	3.0	48.0	5.0				
	2.	cc. gr.	32	0.820	112	2.25	8.75	15.0	11.5	13.0	15.75	11.0	9.0	7.0	5.0	38.25	6.75				
	3.	cc. gr.	31	0.8205	118	2.0	6.75	13.0	11.0	18.25	15.0	14.0	7.0	4.75	2.5	36.25	5.0				
	4.	cc. gr.	36	0.820	119	1.32	4.25	14.0	19.0	13.75	23.25	10.0	6.0	3.0	1.0	96.0	5.0				
AMERICAN REFINED PETROLEUM.	1.	cc. gr.	25.5	0.809	115	6.5	7.5	7.0	8.0	6.0	9.0	7.75	9.25	11.0	5.0	77.0	28.0				
	2.	cc. gr.	24.5	0.800	100	6.9	8.9	9.0	11.0	8.25	9.0	7.8	8.0	7.0	2.0	77.85	21.15				
	3.	cc. gr.	25.5	0.805	102	8.5	6.5	11.0	12.5	10.5	9.5	6.5	6.5	8.0	7.0	86.5	20.5				
	4.	cc. gr.	24.5	0.805	110	7.5	7.5	8.0	7.0	5.75	6.25	11.5	9.75	9.75	4.75	78.0	26.75				
	5.	cc. gr.	23.5	0.800	105	9.25	11.25	8.0	9.25	5.0	7.0	5.25	7.25	6.25	5.0	74.25	30.75				
	6.	cc. gr.	27.2	0.805	115	4.0	8.5	12.5	11.5	8.75	9.5	9.25	10.5	4.75	4.0	83.25	20.75				
	7.	cc. gr.	21.0	0.800	95	10.25	9.5	8.0	8.0	6.0	6.5	4.5	10.25	9.0	6.5	78.5	28.0				
	8.	cc. gr.	23.5	0.805	110	8.0	8.75	9.0	7.75	6.0	6.25	8.75	5.75	10.75	7.75	78.75	29.25				
	9.	cc. gr.	26.5	0.800	108	7.25	9.75	9.0	7.75	8.75	5.75	5.25	9.75	8.75	10.0	82.0	28.0				
	10.	cc. gr.	23.0	0.800	100	8.0	14.5	12.5	7.75	5.75	6.5	5.75	9.75	6.25	4.25	81.0	23.25				

can only be estimated by a fractionated distillation. Table I. shows the amount of different fractions in several specimens of crude petroleum oil. Table II. gives a comparison between Caucasian and American "refined petroleum," as occurring in commerce.

The general average is thus:—

	Below 150°	150—290°	Above 290°
Caucasian petroleum	8	86.6	5.4 vol. per cent.
American petroleum	16.9	57.1	26.0

We also learn from Table II. that Caucasian petroleum possesses a far higher degree of purity than its American competitor. But it must not be overlooked that the illuminating value does not depend upon the purity. On the contrary, it is just possible that the high-boiling oils of the American petroleum influence less the illuminating effect than the corresponding fraction of the Caucasian product. The flashing test of the portion distilling between 150° and 290° is also considerably in favour of the Caucasian petroleum—viz., 45.5° and 29° respectively. The quantity of oils distilling between 150 and 290 is:—

Caucasian petroleum	13.1 vol. per cent.
American petroleum	42.9

The American refining works purposely mix with the normal petroleum, which boils between 150° and 290°, as much as possible of the low and high-boiling oils, not only to increase the yield, but also to make up for the unfavourable effects of these admixtures—viz., a low flashing-point, high specific gravity and great viscosity.

—S. II.

Comparative Experiments on the Properties of Caucasian and American Petroleum. C. Engler and J. Levin. Dingl. Polyt. J. **261**, 77—87.

THE conclusions arrived at may be summarised as follows:—(1) Caucasian petroleum gives at least as much light as American oil; (2) Although at the commencement American petroleum yields a brighter light, there is considerably less diminution in the light afforded by Caucasian oil, so that at the end of the experiment the latter gives more light than American oil; (3) The consumption of oil for a given illuminating effect is approximately the same with both kinds of oil, but, if anything, it is slightly in favour of Caucasian oil; (4) As a rule, less satisfactory results are obtained when Caucasian oil is burnt in lamps adapted for the use of American oil, or *vice versa*; (5) The illuminating power of the low-boiling fractions of all kinds of petroleum oil is greater than that of the higher-boiling portions; in the case of Russian oil, however, a greater difference is observed in this respect; (6) The fraction of Caucasian oil boiling under 150° contributes less to the illuminating power, and the fraction boiling above 300° has a less injurious effect on the illuminating power, than the corresponding fractions of American oil. This difference is mainly due to the fact that American oil yields about 25 per cent. of distillate above 300°, whilst Russian petroleum does not contain more than 5.25 per cent. of oil boiling above this temperature; (7) Although Russian oil is specifically heavier than American oil, it ascends the wick more readily than the latter, a circumstance which the authors attribute to the higher viscosity possessed by American petroleum—1.15, as compared with 1.07, water being 1.0.

From further carefully-conducted experiments, the following general conclusions were drawn:—I. Comparative measurements as to the illuminating qualities of different kinds of oils only possess any value when they are carried out with different burners, each best suited to the nature of the oil experimented on. II. Also with comparative measurements with single fractions of the oils, burners with draughts of different degrees of velocity must be employed. III. Almost all the numerous measurements of illuminating power hitherto carried out with oils of different origin, and with different boiling fractions, if one and the same petroleum, possess value only in the case of the accidental and narrowly limited conditions afforded in the use of one

lamp; for if the heavier kinds of petroleum, or the higher boiling fractions thereof, be tested with lamps of greater draught, then the ratios of comparison turn round in favour of the heavy oils, and these become more powerfully illuminating than the lighter ones. The recently generally-expressed opinion that the lower-boiling fractions of our burning petroleum oils are of more illuminating power than the higher-boiling ones, is a baseless one. IV. Separation of carbon (smoke) at the wick only takes place—(a) When the petroleum is composed of constituents of too extreme a character with regard to the boiling-point; and (b) When the admission of air in the burner is too weak, considering the heaviness of the oil. V. The test by distillation and the determination of the viscosity furnish the most important key for a preliminary judgment as to the applicability of petroleum for burning in certain classes of lamps.—D. B.

A Second Thioxen. R. Demuth. Ber. **19**, 1857—1859.

ALL endeavours to obtain a second thiophendicarboxylic acid having been unsuccessful, the author attempted to prepare an isomeric thioxen in order to determine whether by oxidising the two methyl groups a new dicarboxylic acid could be obtained. For this purpose γ -thiotolene was converted into the iodo-product, and the latter mixed with methyl iodide and sodium contained in an ethereal solution. After allowing the mixture to stand for several days in the cold, the ether was expelled and the product of the reaction subjected to distillation. On fractionating the distillate a new thioxen boiling between 138—140° was obtained, having a sp. gr. of 0.9777 at 21° compared with water at the same temperature. Mesinger's thioxen yields a dicarboxylic acid on oxidation; the new compound is, however, completely decomposed when subjected to a similar treatment.—D. B.

On Benzene containing Thiophen. C. Willgerodt. Journ. Pract. Chem. **33**, 479.

ON passing chlorine into commercial benzene, boiling at 80—85°, without addition of a chlorine carrier, a turbidity appears; but the solution soon becomes clear again, and shortly afterwards a strong evolution of hydrochloric acid proves that a substitution is taking place. This is owing to the thiophen present in the benzene, the former being chlorinated, for no hydrochloric acid is evolved on passing chlorine into pure benzene.

The author has tried to make use of the reaction on a large scale. Chlorine was passed into 4 kgms. of tolerably pure benzene, which contained some thiophen, for four hours; light was partly excluded, and the solution cooled with ice. On redistilling, the chief portion went over at 80—85°. A portion, which was freed of chlorine, contained no more thiophen. There were furthermore obtained: at 85—95°, 42 grms.; at 95—110°, 53 grms.; at 110—120°, 7 grms.; at 120—130°, 18 grms.; at 130—190°, 30 grms.; at 190—210°, 150 grms. From the last fraction benzene hexachloride separated out on cooling. It is as yet undecided whether it will be possible to prepare pure chlorothiophen from commercial benzene. Combination of chlorine with benzene may no doubt be prevented by the better exclusion of light, and by reducing the time for chlorinating to a minimum.—A. R.

IV.—COLOURING MATTERS AND DYES.

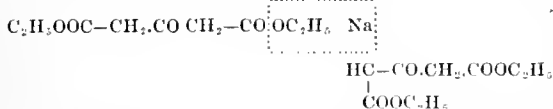
The Composition of Magdala Red. P. Julius. Ber. **19**, 1365—1368.

HOFMANN was the first to study the constitution of this body, which he considered to belong to the rosaniline group, having the formula $C_{30}H_{21}N_3HCl.H_2O$. The substance, which is the hydrochloride of a base, was purified by converting it into the sulphate, and re-crystallising from alcohol acidified with H_2SO_4 . The author is led by a series of careful analyses to modify the above formula of Hofmann's to $C_{30}H_{21}N_4Cl$, and from this and its mode of formation, considers it to belong to the salitrines.

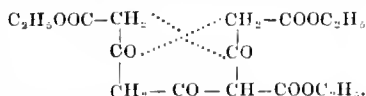
—J. B. C.

Synthesis of Orcinol from Acetone Dicarboxylic-ether.
H. Cornelius and H. von Pechmann. Ber. **19**, 1446—1451.

By an analogous reaction to that by which Baeyer prepared phloroglucinol from malonic ether, the authors have succeeded in synthesising orcinol. The reaction proceeds in two stages. In the first place by acting upon acetone dicarboxylic-ether with its sodium compound, condensation follows:—



In the second phase a six carbon ring is formed by union of a methylene carbon and a ketone carbon atom, with elimination of water :—



The condensation occurring in one of the two directions indicated by the dotted lines. In the third phase molecular change occurs, the sodium compound of dioxyphenyl-aceto-dicarboxylic ether being formed.

By saponification of the ether carbonic acid is at the same time eliminated and symmetrical dioxiphenylacetic acid is formed. To obtain orcinol from this body it is only necessary to distil the silver salt in a current of CO_2 . The resulting compound gave the melting point and all the other physical properties of pure orcinol.

—J. B. C.

Thiophenol and the α -Naphthol of the Thiophen Group.
A. Biedermann. Ber. **19**, 1615—1620.

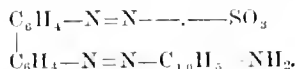
THE author employed the method of Otto in order to obtain the mercaptan of thiophen C_4H_3S-SH .

Thiophen is first converted into the sulphonic acid by shaking thiophen dissolved in petroleum ether with strong sulphuric acid. This is converted into thiophen sulphonic chloride, and then by the usual method into the zinc salt of the sulphinic acid. This on reduction with zinc and hydrochloric acid gives thiophen sulphydrylate, which may be distilled off by steam. It is a yellowish oil boiling at 166°. The yield is very small. It gives the isatin reaction, and with diazo-compounds combines to form colouring matters. As Pittig and Jayne have shown, isophenyl-crotonic acid on heating gives α -naphthol. On heating thiophen aldehyde with sodium succinate and acetic anhydride the mass becomes brown and CO_2 is evolved. After extracting the unaltered aldehyde with ether, and adding caustic soda, a current of CO_2 was passed through the solution, which precipitated the oxythionaphthene as a flocculent mass. This was crystallised from ether. Oxythionaphthene combines with diazo-compounds to form colouring matters. In most of its reactions it closely resembles α -naphthol.—J. B. C.

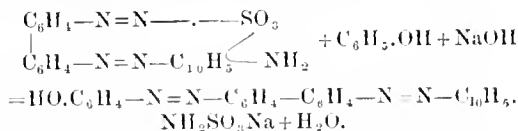
A New Synthesis of Mixed Azo-colouring Matters from Aromatic Diamines. Martin Lange. Ber. 19, 1697—1700.

O. WALLACH and NIETZKI (*Ber.* **15**, 2825; and **17**, 343) have described the formation of mixed azo-compounds from aromatic diamines, by diazotising the monoacetyl compound of the diamine, combining this with a phenol, removing the acetyl group by boiling hydrochloric acid, again diazotising, and finally combining this diazo-body with either a phenol or an amine. This process has the disadvantage of small yields of the substances, because by continued heating with hydrochloric acid amidoazo-compounds are considerably decomposed. It is also not possible with this method to form diazo-compounds containing as terminals two different amines. From the following, however, it will be seen that this can easily be done, starting from compounds of the tetrazodiphenyl class. In the formation of colouring matters from tetrazo-

diphenyl and sulphonic or carboxylic acids of aromatic amines, the author noticed the regular formation of intermediate insoluble compounds which were converted—apparently simply on standing some time—into the colouring matters. Investigation showed that these insoluble substances are formed when one molecule of tetrazodiphenyl reacts with one molecule of the aromatic amido-acid, and it also proved that when these bodies are brought together with an alkaline solution of a phenol or amine, or their sulphonic acids, the new diazo-colouring matters are at once formed. These new intermediary compounds have the character of anhydrides of diazo-sulphonic acids. That obtained by the action of 1 mol. tetrazo-diphenyl on 1 mol. naphthionic acid has the formula—



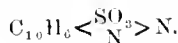
It is almost insoluble in water, ammonia, and alkaline carbonate solutions. If boiled with water the diazo-group is replaced. Both substances thus obtained are colouring matters differing in shade. When this diazo-compound is brought into contact with a phenol or amine in alkaline solution, it reacts at once to form colouring matters, according to the following equation, for example, with phenol :-



A number of similar colouring matters have been patented and manufactured by Messrs. Ever & Pick, of Berlin; they dye direct on cotton. As from tetrazodiphenyl, so can similar diazoanhydro-sulphonic acids be obtained from all tetrazo-compounds which contain the two diazo-groups in para-position to each other, or to the junction of the two benzene nuclei.—T. L. B.

β-Naphthylaminesulphonic Acid. S. Forsling. Ber. **19**, 1715—1716.

By the action of strong sulphuric acid on β -naphthylamine at 140° , a sulphonic acid is obtained, which crystallises from water in fine white needles. The potassium salt $C_{10}H_6NH_2SO_3K$ is extremely soluble in water and forms microscopic needles. All the water of crystallisation of the sodium salt $C_{10}H_6NH_2SO_3Na + 4H_2O$ is removed by standing over sulphuric acid. The barium salt forms fine needles. The free acid suspended in a mixture of alcohol and ether, and exposed to a stream of nitrous acid, is converted into the diazo-compound—



This diazo-compound boiled with hydrochloric acid, converted into the potash salt, dried and then heated with phosphorus pentachloride, gave a β -chloronaphthalene-sulphonic chloride, melting at 128–129°. This compound is very probably identical with that described by K. Arnele, melting at 129°, obtained from the β -chloronaphthalene-sulphonic acid derived from β -chloronaphthalene.

- T. L. B.

On the Toluidines. Leo Lewy. Ber. 19, 1717—1719.

ANILINE combines with phosphoric acid to form only two of the three theoretically possible salts—viz., the secondary $(C_6H_7N)_2H_3PO_4$, and the tertiary $(C_6H_7N)_3H_3PO_4$; on drying, the latter loses aniline and is converted into the former. Paratoluidine forms only the secondary phosphate $(C_7H_9N)_2H_3PO_4$, which is very insoluble in cold water; whilst orthotoluidine forms only the more easily soluble primary salt $C_7H_9N.H_3PO_4$, and *never* the secondary or tertiary. When a solution of orthotoluidine phosphate is shaken with aniline or paratoluidine, the orthotoluidine is liberated and secondary aniline or paratoluidine phosphate is formed; upon this fact is

based the following method of separating the toluidines in commercial toluidine. In order to obtain a very pure orthotoluidine it is well to use an excess of acid on the quantity necessary to combine with the paratoluidine present. 100cc. toluidine, containing, for example, 35 per cent. paratoluidine, are well mixed with 68cc. of a 21 per cent. phosphoric acid solution to form the secondary paratoluidine phosphate, and with other 19.3cc. phosphoric acid to form the primary phosphate with five per cent. orthotoluidine; 30cc. water are then added, the whole well shaken together and left over night. The mixture must be cooled during the addition of the acid. The orthotoluidine filtered and pressed from the paratoluidine phosphate crystals, and then rectified, does not contain sufficient paratoluidine for detection by Rosenstiehl's method.—T. L. B.

A New Class of Azo-colouring Matters. C. A. Martins. Ber. 19, 1755—1756.

THIS paper is of a controversial nature, discussing and confirming the results described by Dr. Lange (see abstract on p. 481), at the same time claiming priority of invention for himself and colleagues. The reaction is stated to be a general one in all cases when tetrazo-diphenyl, tetrazo-ditolyl, or tetrazo-dixylyl salts react with amines, phenols, or their sulphonic or carboxylic acids.—T. L. B.

New Synthesis of Triphenylmethane. H. Griepentrog. Ber. 19, 1876.

THE author has investigated the action of benzaldehyde on toluene in the presence of zinc chloride, the object being to ascertain whether it was possible to effect partial condensation of the benzaldehyde with the methyl group of toluene, in which case it was anticipated that stilbene would be formed, $C_6H_5CH=CHC_6H_5$. It was found, however, that the hydrogen atoms of the benzene nucleus only were eliminated, hydrocarbons of the triphenylmethane group being formed. On applying this re-action to benzene, triphenylmethane was obtained in considerable quantity, its formation being expressed by the following equation:—



—D. B.

An Improvement in the Manufacture of α - or β -Carbanaphthol Acid Alkaline Salts. J. Y. Johnson, London. From Dr. C. Kolbe and C. Rentsch, Radebeul, Saxony. Eng. Pat. 8155, June 19, 1886. 4d.

ACCORDING to the present invention the carbonic anhydride is caused to act on the alkaline salts of α - or β -naphthol, not at an ordinary temperature as in Patent 6134, May 19, 1885 (this Journal, 1885, 531), but under pressure in a closed vessel, and at a temperature at from 120—145°, by which means the alkaline salts are in a nascent state converted into the respective naphthol carbonic alkaline salts.—D. B.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

The Fibre of the German Indianrubber Plants. G. Kassir. Archiv. der Pharmacie, 1886, 224, 97.

THE author has determined the amount of caoutchouc contained in the *Asclepias Cornutia* (Decaisne). The fruit shells were found to be filled with long silky hairs (serving for the dissemination of the flat brownish-red seeds), which from their beautiful lustre had already excited the attention of many, and have occasionally been worked up into textile fabrics. In 1760, La Rouvière, of France, used this wool, partly alone, though for the most part mixed with other fibres, for spinning and weaving into beautiful silk-like fabrics. Fries, of Münsterberg, and Schmieder, of Liegnitz, who tried to utilise these silk plants, found that besides the silky wool, the bast of the *Asclepias* deserves special attention, since when properly prepared it is pure white, very lustrous, and well suited for spinning purposes. The

sprouts, still with leaf, gathered in May, August, and September, when dried and tested gave the following results:—

	May.	Aug.	Sept.
Extract	2.17	5.81	7.20
Crude caoutchouc	0.26	1.45	2.37
Pure caoutchouc	0.15	1.13	1.61

—B. H.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

On the Consumption of Acid in Discharging Indigo-blue Prints. F. Langmann. Dingl. Polyt. J. 261, 43—45.

FOR discharging indigo-blue prints, chromic acid is now chiefly used, which, printed in the form of potassium chromate, and set free during the passage of the goods through acids, bleaches the indigo. The acid used for discharging is a mixture of sulphuric and oxalic acids; the latter on account of its reducing power prevents any further action of an excess of chromic acid. The purpose of this investigation is to measure the consumption of these acids. The discharging apparatus used consisted of three vats. The first vat had a capacity of about 300 litres, was lined with lead, and provided with three rollers and a vertical heating pipe. It was charged with fresh acid at the beginning of the experiment, and during the experiment replenished gradually, first with 300 litres of spent acid from the previous day's work, and then with 150 litres of fresh acid of the same composition as that with which the vat was first charged. The goods passed from this vat through the two following vats, in which they were washed. The following analyses show the composition of the acids: *a*, the fresh acid in the discharging vat as used at first and at last; *b*, the spent acid used to replenish; *c*, the composition of the acid in the discharging vat when 150 litres of acid *b* had been used; *d*, the same after the whole 300 litres of acid *b* had been used; *d* shows the composition in the vat after 150 litres of fresh acid (*a*) had been added. Samples *w*₁, *w*₂, *w*₃ show the acidity of the washings at the time samples *c*, *d*, and *e* were taken:—

Samples.	H ₂ SO ₄ .	C ₂ O ₄ H ₂ +2H ₂ O.	Acidity of Washings.
<i>a</i> ,	9.08	7.77	—
<i>b</i> ,	10.23	5.60	—
<i>c</i> ,	7.05	9.53	W ₁ 0.4
<i>d</i> ,	7.00	7.77	W ₂ 0.45
<i>e</i> ,	11.33	5.71	W ₃ 0.76

The final result is represented by the samples *b* and *e*, which show a considerable decrease of oxalic acid as compared with *a*. The series *a*, *b*, *c*, shows the peculiarity that the amount of sulphuric acid decreases from 9 to 7.05 per cent., although the vat was fed with an acid of 10 per cent., and the amount of oxalic acid increases from 7.7 per cent. to 9.53 per cent., in spite of the fact that the vat was fed with an acid containing only 5.60 per cent. of oxalic acid. The relative quantities of sulphuric acid and oxalic acid used are, however, evidently advantageous, the oxalic acid being well utilised, whilst the activity of the mixture remains constant, owing to the increase of the percentage of sulphuric acid.

Action of Aromatic Bases upon Manganese Brown. F. Rettig. Bull. Soc. Ind. Mulhouse, 1886, 174—175.

IF a piece of cloth dyed with manganese be passed through a solution of aniline hydrochloride or sulphate, a beautiful deep black is obtained, which is fast to soap. Naphthylamine forms under similar conditions a puce, β -naphthylamine a maroon shade. The author has experimented with a series of aromatic bases, and has obtained the following results:—4grms. per litre of the sulphate were

employed. The solution was acidified with 0.4gm. sulphuric acid, and the dye-bath raised from the ordinary temperature, gradually, to 55° C., for three-quarters of an hour.

1. Aniline alone gives a deep black.
 2. The presence of the methyl group in the *ortho* position does not modify to any extent the shade. It is, however, slightly bluer and not so intense.
 3. The presence of methyl in the *meta* position changes the shade to violet (meta-toluidine).
 4. The methyl group in the *para* position gives a weak brown shade, not very fast to soap. Other methyl groups have no sensible effect.
 5. Bases which have the methyl groups in *meta* and *ortho* positions, adjacent orthoxylidine, symmetrical meta-xylidine, and paraxylidine; the first two give a maroon, the latter a very pretty grey.
- None of these bases, excepting meta-toluidine, have a practical value. The presence of the hydroxyl group in the *para* position to the amido group, gives a fast and brilliant manganese brown.—J. B. C.

Improvements in and relating to Mordants for Use in Dyeing or Printing Calico and other Fabrics. H. H. Lake, London. From C. N. Waite, Mass., U.S.A. Eng. Pat. 6070, May 4, 1886. 4d.

This invention relates to a improved mordant for fixing aniline or other dyes on cotton yarn or cloth. The mordant consists of antimony dissolved in lactic acid, and is employed in combination with tannin or other suitable materials. Four hundred pounds of lactic acid (25%) are mixed with fifty pounds of strong nitric acid and as much powdered antimony as the acids can dissolve, a small excess being preferred to avoid the formation of antimonious oxide instead of antimonious oxide, the former not being soluble in lactic acid. On completion of the reaction, seventy pounds of dry carbonate of soda are added, which neutralises two-thirds of the lactic acid, and does not precipitate the antimony. In cases where the acid cannot do harm, the soda is not added. The goods or yarn are first run through a suitable tannin bath, slightly washed, and then treated in a bath of the above mordant. For deep shades the inventor uses 4–5 pounds of lactate of antimony per hundred pounds of yarn or cloth. It is claimed that the antimony remains in solution, if the bath be cold, even if all the acid has been neutralised, and that the bath can be completely exhausted. Also, that the above mixture has many advantages over tartar-emetic, double oxalate of antimony and potash, or “oxy-muriate of antimony.” —H. A. R.

VII.—ACIDS, ALKALIS, AND SALTS.

On the Action of Potassium Sulphate on Metallic Phosphates at High Temperatures. H. Grandean. Ann. Chim. Phys. 1886, 8, 193.

THE author has obtained a number of crystalline compounds by the action of excess of potassium sulphate on phosphates, at temperatures of 800° to 1500°. The nature of the product formed depends on the base present as phosphate, and on the temperature. The phosphates studied are divided into three groups, according to the products formed. (1) Phosphates of Ca, Mg, Zn, Cl, Ba and Sr, which form double phosphates of the formula $MKPO_4$. Barium and strontium form also sulphates. (2) The phosphates of Al, Be, Fe, Ni, Co, Cu, Mn, Cr, U yield at low temperatures double phosphates of the type $MKPO_4$; at high temperatures, crystalline oxides. The last three metals also form potassium salts, manganate, chromate and uranate respectively. (3) The third group includes the phosphates of Ce, Di and La, which yield phosphates having the formula MPO_4 at low temperatures, but at the highest temperatures crystalline oxides. A large number of crystalline compounds have thus been prepared, and the author has succeeded in producing the minerals erythrolite and phosphocerite, and also zircon and cassiterite. He believes that it will be possible to prepare spinel, chrysoberyl, and other naturally occurring aluminates.—S. Y.

New Mode of Formation of Pentathionic Acid. T. Salzer. Ber. 19, 1696.

It is known that thiosulphuric acid when liberated from any of its salts is almost immediately resolved into sulphurous acid and sulphur. The author found that on adding a small amount of potassium arsenite the decomposition is prevented more or less completely. The solution after filtration exhibits the reactions of pentathionic acid. The action is ascribed to the probable formation of intermediate product ($As_2O_3S_5$?). —D. B.

On the Dissociation of Calcium Carbonate. H. Le Chatelier. Compt. Rend. 102, 1243.

THE alterations in the tension of dissociation of calcium carbonate produced by a rise of temperature have never been studied up to the present. The author attempted to fill up this deficiency. He employed a thermo-electrical element for measuring the temperature. Calcium carbonate in different states (marble, chalk, or chemically precipitated) showed the same tension at equal temperatures, the equilibrium being produced in less time, if the matter was in a very fine division. The result of experiments was as follows:—

Temperature.	Tension of Dissociation.
517	27mm.
610	16
625	56
710	255
715	289
810	678
812	763
865	1333

The tension of dissociation therefore equals the pressure of the atmosphere at about 812° C. On heating the substance quickly, the temperature even rises to 925°, where it remains constant, probably owing to the rapid decomposition which is going on, and which absorbs much heat. The author observed the same phenomenon with gypsum and slaked lime. (Compare similar investigations by Kahlbaum, Ber. 18, 3146).—S. H.

Improvements in and relating to the Decomposition by means of Magnesia of the Residual Ammonium Chloride of the Ammonia Soda Process. W. F. R. Weldon. From Pechiney & Co., Salindres, France. Eng. Pat. 9227, August 1, 1885. 1s. 1d.

IN the ammonia soda process the mother-liquor from which sodium bicarbonate has been separated is a mixed solution of ammonium chloride, sodium chloride, sodium bicarbonate and ammonium bicarbonate. In order to recover the ammonia from this liquor, it is heated, whereby all the ammonium bicarbonate is driven off, and also a further quantity of ammonium bicarbonate formed by the reaction of sodium bicarbonate on ammonium chloride. The remaining solution only contains sodium and ammonium chloride, from which all the ammonia is liberated by the addition of milk of lime. The chlorine of the ammonium chloride is thus converted into calcium chloride. The latter, however, is a body from which it is not yet possible industrially to separate its chlorine, while means are known to recover chlorine from magnesium chloride. The inventors therefore endeavoured to replace lime by magnesia. But, although lime readily decomposes ammonia compounds, the same cannot be said of magnesia, if the latter be used for that purpose in the same manner as lime. If the conditions of proceeding are altered, magnesia decomposes ammonia salts nearly as readily as lime, and the present invention consists in treating the mother-liquor under conditions securing those objects. Ammonium bicarbonate is first driven off by heating, and a sufficient quantity of magnesia is then added. The mixture of magnesia with solution of ammonium and sodium chloride is then passed through a series of compartments, all the while being so agitated as to keep its magnesia in suspension. Steam is passed through the mixture, but travelling in the opposite direction, and special care is taken to maintain the

temperature of the compartments, that in none of them condensation of the steam may take place. An apparatus upon these principles is illustrated in the annexed drawings, where Fig. 1 is a vertical section along the line A B; Fig. 2 is a horizontal section along the line E F of Fig. 1; Fig. 3 shows the whole apparatus in elevation; Fig. 4 is a horizontal section along the line

centre of them all passes the vertical shaft *n*, working an agitator in each of them. Fig. 5 shows a vertical section of *C*³. The shaft *n* is surrounded by a hood *z*, and outside of it and enclosing it is a somewhat similar hood *x*. The mixture of steam and ammonia which passes off from the vessel *C*² is thereby compelled to pass first into the conical part of *z*, then rises to the

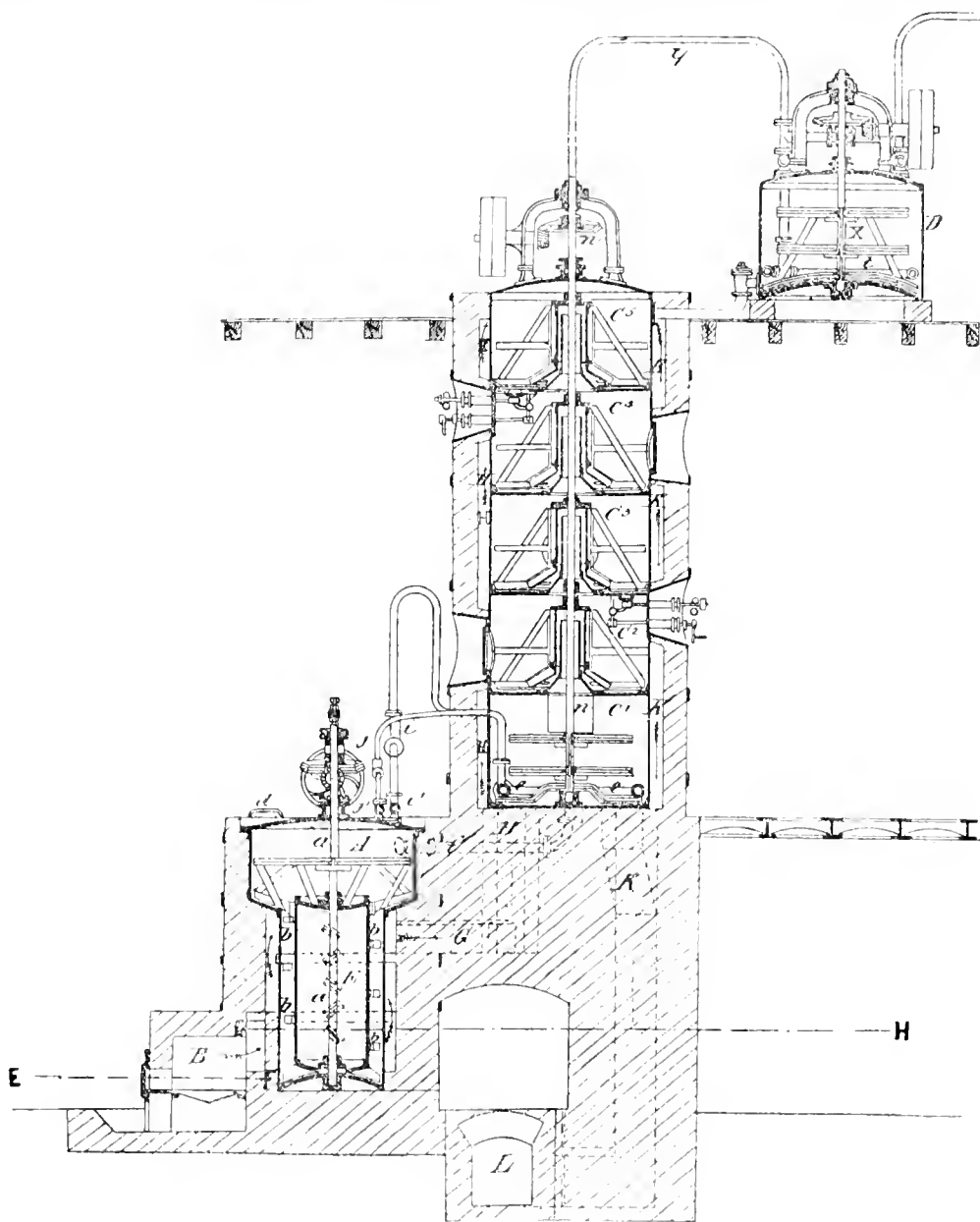


FIG. 1.

K L of Fig. 3. A A are two vertical boilers: *C*¹, *C*², *C*³, *C*⁴, *C*⁵, are a series of vessels superposed one above the other and surrounded by masonry. With the boilers A A they form a distilling column. The products of combustion from the fireplaces B B (Fig. 1) pass only upon the lower part of the two boilers and then pass by the flues G and H through the passages H H H and K K K into the flue L, and thence to the chimney. By thus traversing the spaces between the vessels C and the masonry, the contents of the vessels C are kept at such a temperature that no steam can condense in them. The five vessels, *C*¹ to *C*⁵, are all alike. Through the

cylindrical part of that hood and then passes down into the liquid contained in *C*³ by the annular space between *z* and *x*, finally issuing either from under the rim of the conical part of *x* or through holes near its lower edge. In the bottom of each of the five vessels *C*¹ to *C*⁵ is a kind of slide valve M (Fig. 6), by which from time to time the contents of the vessels *C*⁵ are transferred into *C*⁴, those of *C*⁴ into *C*³ and so forth. The vessel D (Fig. 1) is also furnished with an agitator. Near the bottom is a circular pipe *t*, perforated with holes, which is connected with *C*⁵ by means of pipe *gamma*. Liquid from D can be run into *C*⁵ by a pipe. In work-

ing this apparatus the mixture of steam and ammonia disengaged in A A passes into the perforated circular pipe *c c*, placed near the bottom of *C*¹, and then rises upwards through the liquid which is contained

the further quantity of ammonia which it carries off from *C*¹. In thus traversing the vessels *C*¹ to *C*³ successively, it continually gathers more and more vapour of ammonia without losing any of its steam, so that

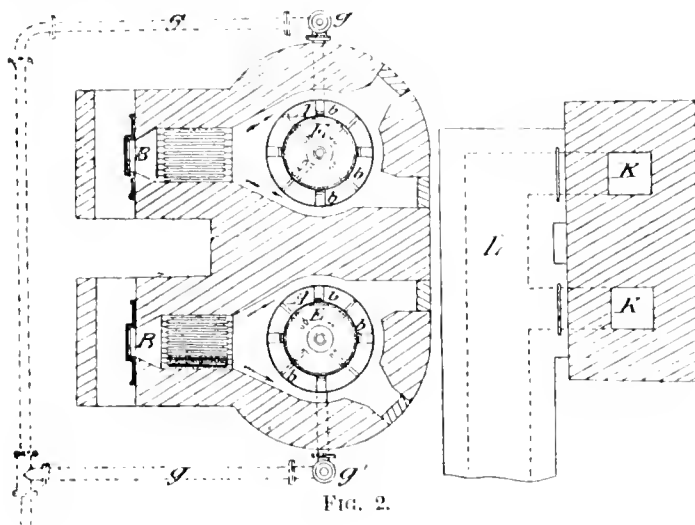


FIG. 2.

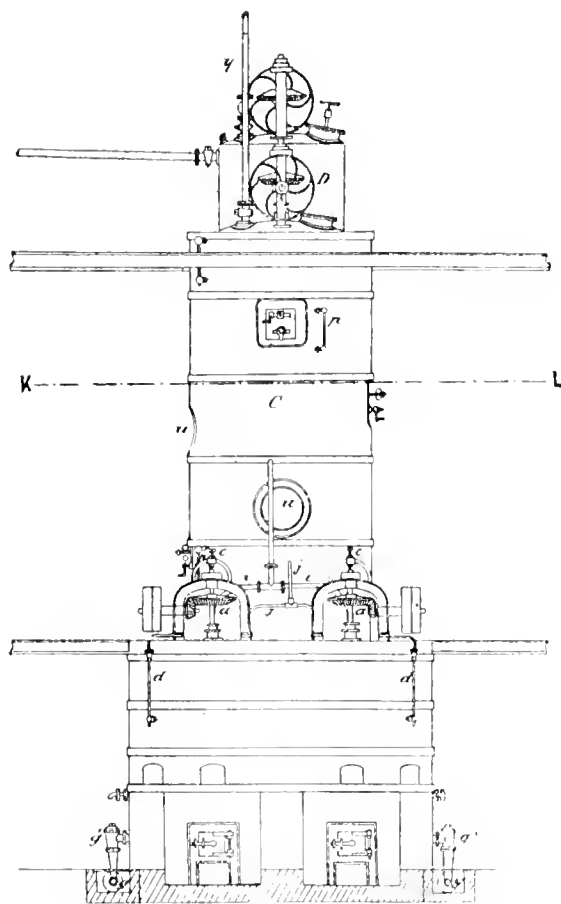


FIG. 3.

in that vessel. The contents of *C*¹ being maintained at such temperature that steam cannot condense in it, all the steam passes into *C*², accompanied by the vapour of ammonia which passed off with it from A A, and with

the liquid in the different vessels *C* does not become diluted when reaching A A, in which it is concentrated. When the liquor in A A has reached that degree of concentration that sodium chloride commences to salt

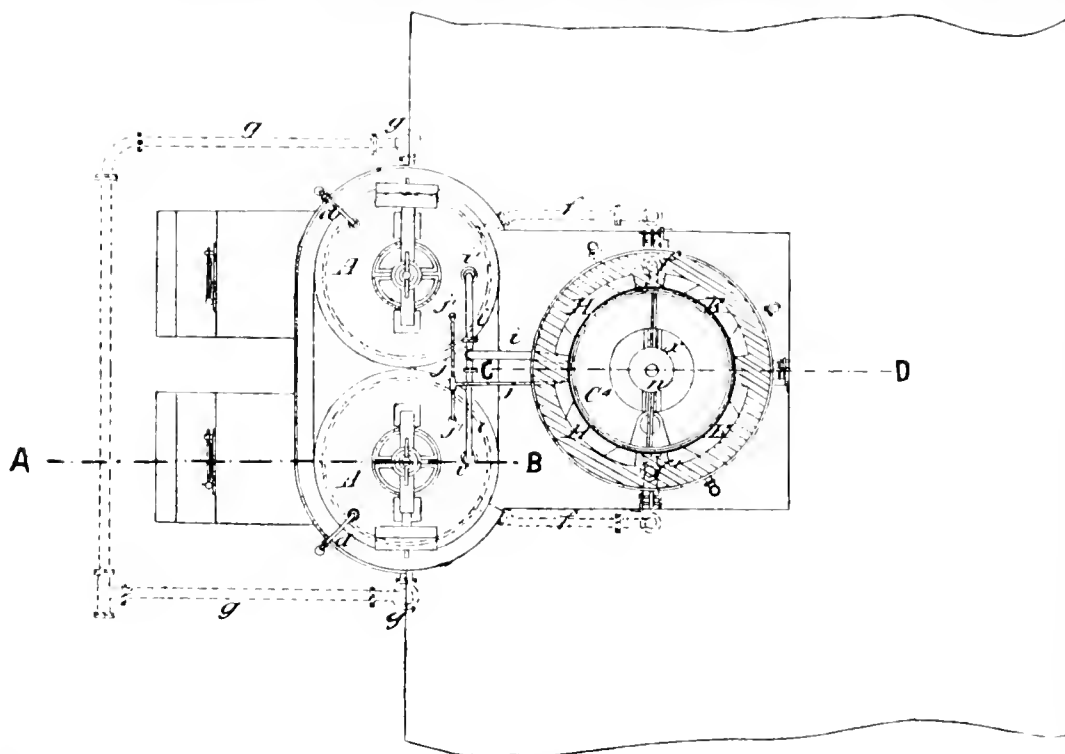


FIG. 4.

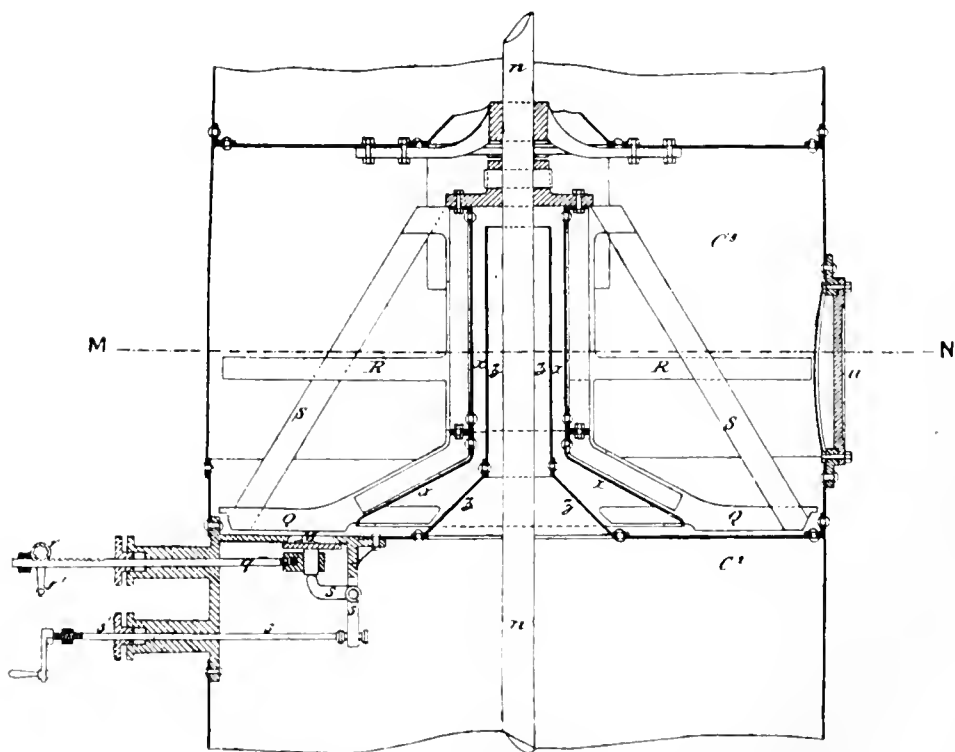


FIG. 5.

out, all its ammonia has been driven off and the contents of A A is then partially discharged, and that of C¹ run into the boiler A. The contents of C² is then transferred into C¹, the contents of C³ into C² and so forth, whereas the vessel D is re-charged with new

On evaporating, the foreign salts separate out and are fished out, and on allowing the liquor to cool, ammonium bichromate crystallises out. The salts fished out are utilised for fusing fresh batches of chrome ore.

—S. H.

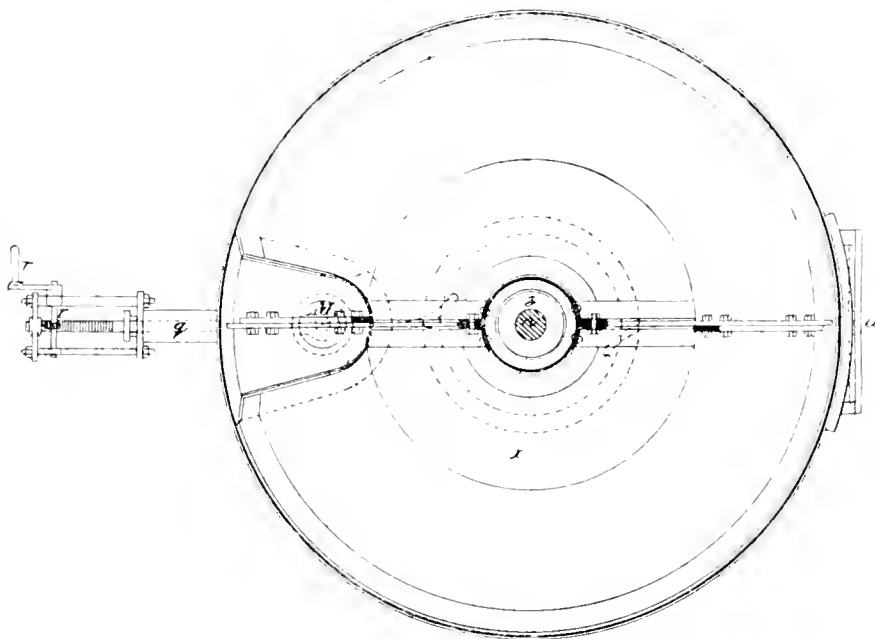


FIG. 6.

mother-liquor, from which ammonium bicarbonate has been previously driven off. A quantity of magnesia equivalent to the amount of ammonium chloride is then added to the liquor in D, and the process of distilling at once continued. The mixture of steam and ammonia passes from D either into a condensation or into a rectification apparatus, as may be preferred in each particular case.—S. H.

Improvements in Mode of Procedure for Decomposing by Magnesia the Mother-liquor of the Ammonia Soda Process. W. F. R. Weldon. From Pechiney & Co., Salindres, France. Eng. Pat. 9831, August 19, 1885. 8d.

A LITERAL REPETITION of the preceding, but under an altered title.—S. H.

Improvements in the Manufacture of Ammonium Bichromate. J. Hood, London. Eng. Pat. 10,700, September 9, 1885. 6d.

CHROME ORE is furnaceed in the customary manner with soda salts for the manufacture of sodium chromate, and the resulting mass lixiviated. To the solution thus obtained two equivalents of acid are added—that is to say, double the amount of acid requisite to convert sodium monochromate into bichromate. Ammoniacal gas is then passed into this solution, until all the free acid is saturated. The solution now contains a bichromate and a sulphate, chloride or nitrate, according as sulphuric, hydrochloric, or nitric acid was the acid used.

Process and Apparatus for Distilling Ammonia. W. C. Wren, New York. Eng. Pat. 6999, May 25, 1886. 8d.

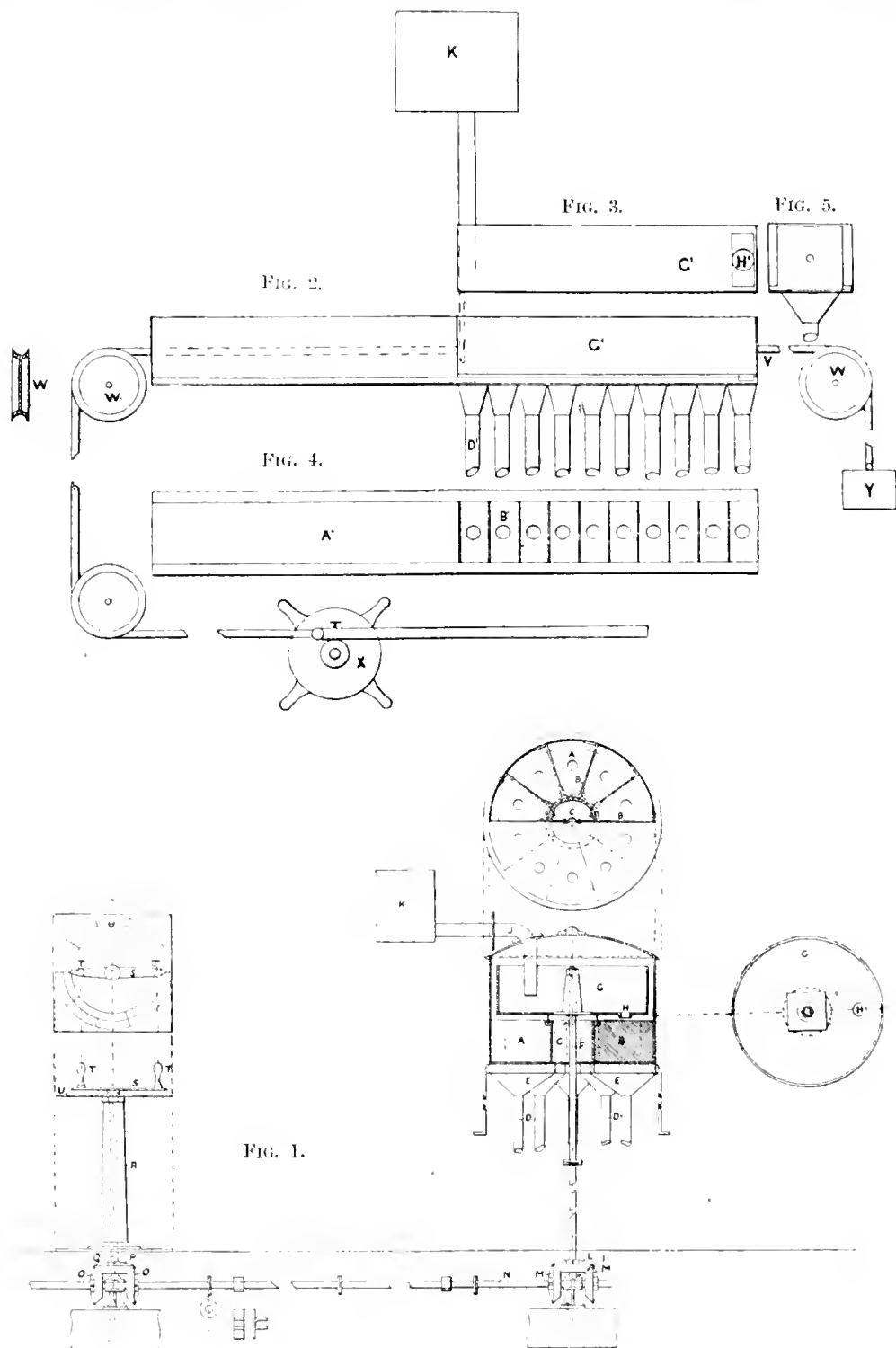
THE object of this invention is to convert the gas produced by the distillation of ammoniacal liquor into pure anhydrous ammonia without the use of compression pumps or similar devices. Ammonia water is heated in a still made of strong boiler plates, and capable of withstanding a very high pressure. The gases evolved are carried away by an upright pipe extending from the top of the still to a height of at least forty feet above the base. The upright pipe is in connection with a coil, which enters the top of a receiving tank and extends nearly to the bottom of it. Cold water is made to trickle over the surface of the coil and the tall upright pipe. In the course of distilling ammonia, gas and steam is driven into the upright pipe, but the latter is soon condensed, owing to the great height to which the upright pipe is carried, as well as by the effect of the water trickling over the outside of the pipe, and falls back into the still, leaving the ammoniacal gas to pass through the cooling worm into the receiver, where it is liquefied by the continuous pressure from the still.—S. H.

Improved Means of or Apparatus for Distributing or Conveying Acids or other Liquors to the Cisterns or Tanks of Chemical Towers, or to Vats or other Receptacles. J. Brock and E. Saye, Widnes. Eng. Pat. 11,492, September 26, 1885. 8d.

A CLOSED BOX A (Fig. 1) lined with a suitable anti-corrosive metal or material is divided into a number of

compartments B, radiating from the centre from a hollow space C to the edge of the box. Pipes D lead from each division to the corresponding cisterns. Through the

G is so arranged that on rotating the shaft, the openings H in the drum G may be brought over any required division B in the distributing box A. A pipe J passes



hollow space C passes a vertical shaft F, extending above the radial divisions B, and carrying a rotating drum G, having openings H in its bottom. The drum G is so arranged that on rotating the shaft, the openings H in the drum G may be brought over any required division B in the distributing box A. A pipe J passes

its end, gearing with another bevel wheel M, carried by a horizontal shaft N proceeding to the engine room, and carrying at its other end another bevel wheel O gearing with a wheel P, on an upright shaft Q, and carrying at its top a pointer S and handles T to move the pointer over a dial U, divided to correspond with the number of divisions B in the box A. A modification of the foregoing apparatus is shown in Figs. 2, 3, 4, 5. In place of the drum an oblong rectangular box G, having an opening H in its bottom, and sliding over a corresponding distributing box A', with divisions B, may be used. The sliding box can be moved by a rack and pinion and attached to a balance weight Y or by cords, ropes or chains passing over pulleys W, and moved by wheel X carrying a pointer. The box is connected with a dial as before described, so as to indicate the numbers of divisions to be supplied, the movement of the handles operating the sliding box.—S. H.

Improvements in the Manufacture of Sulphuric Acid.
H. H. Lake, London. From U. Cummings, New York. Eng. Pat. 7355, June 1, 1886. 4d.

This invention has for its object the manufacture of sulphuric acid from gypsum, obtaining hydraulic cement as a by-product. Gypsum—i.e., calcium sulphate and clay are intimately mixed, and the mixture is moulded into blocks by means of a small quantity of water. The mass is then calcined in a suitable kiln, when silica combines with lime and alumina, producing a hydraulic cement, whereas the sulphuric acid is expelled either in the form of vapour or it is decomposed into sulphurous acid and oxygen. These gases are converted into sulphuric acid by the usual method.—S. H.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Fire-clay and Fire-clay Wares. Dingl. Polyt. J. 261, 35—43.

C. BISCHOF publishes two analyses of fire-clay from Eisenberg, which had the following composition :—

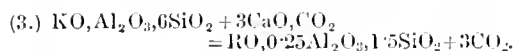
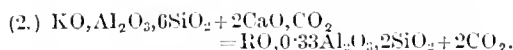
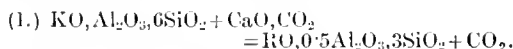
	I.	II.
Al ₂ O ₃	5'40 %	21'02 %
SiO ₂ , chemically combined	5'11	30'53
SiO ₂ , mechanically mixed	81'59	34'19
MgO	0'09	0'10
CaO	0'20	0'37
Fe ₂ O ₃	0'21	0'87
K ₂ O	0'61	2'10
Loss on igniting	3'74	7'38

No. I. was remarkably fireproof, and goods made of it did not alter their shape, when heated up to the fusing point of platinum. The unctuous clay (No. II.) swelled up at that temperature. Clay from Brissen, dried at 120° C., tested thus : Al₂O₃ 39'93 per cent., SiO₂ 44'88 per cent., MgO 0'08 per cent., CaO 0'21 per cent., Fe₂O₃ 0'99 per cent., K₂O 0'52 per cent., CaO on igniting 13'03 per cent. This clay is also very fireproof. Besides the chemical analysis, it is well worth while to examine clay for its physical properties. If the specific gravity of burnt fire-clay is high, it will resist the action of heat better than the lighter and more porous kind. If moderately burnt clay shrinks considerably at a much increased heat, goods made of it will be of an inferior quality, and such clay is quite useless for arch bricks. The power of absorption is also important. If fire-clay absorbs liquid slags easily it will not resist the heat well.

II. Seger (*Thonindustrie Ztg.* 1886, 170) examined the black clay from Loethain. It is darkish-brown, very plastic, and after burning of a very white colour. It tested thus : SiO₂ 56'09 per cent., Al₂O₃ 30'10 per cent., Fe₂O₃ 0'76 per cent., CaO 0'38 per cent., MgO trace, K₂O 0'69 per cent., H₂O and organic matter 12'22 per cent. It therefore consisted of 80'15 parts clay proper, 19'20 parts quartz, and 0'65 parts felspar. The clay proper is composed of : SiO₂ 45'30 per cent., Al₂O₃ 37'24 per cent., Fe₂O₃ 0'94 per cent., CaO 6'47 per cent., K₂O 0'86 per cent., H₂O 15'18 per cent. The same investigator (*Thonindustrie Ztg.* 1886, 135) prepared standard cones for the determination of high temperatures in the pottery oven. The attainment of a certain heat is estimated by the fusing of a glazing mixture of known composition. The analysis of the materials of which the cones were made was as follows :—

	Rorstrand Felspar.	Kaolin.	Norwegian Quartz.	Carrarian Marble.
SiO ₂	61'32	46'87	98'52	1'00
Al ₂ O ₃	19'41	38'56	1'04	0'12
Fe ₂ O ₃	0'11	0'83	0'01	
CaO	trace	trace	—	51'93
MgO	0'35	trace	—	0'21
K ₂ O	12'90	1'06	0'40	—
Na ₂ O	2'10		—	—
Loss on igniting	0'57	12'73	—	—
CO ₂	—	—	—	43'76

For the sake of computing the formulas, mentioned later on, these minerals were considered as chemically pure. If one equivalent of felspar be mixed with one, two, or three equivalents of calcium carbonate the following formulas represent the mixtures, in which the alkaline flux, potash and lime, is combined under the common heading RO :—



According to our present knowledge we should expect that mixtures containing more flux and less alumina and silica than felspar, would be more easily fusible than felspar. The latter contains one equivalent of alumina and six equivalents of silica, whereas the mixtures mentioned above represent a trisilicate and a one-and-a-half silicate with one-half, one-third, and one-quarter equivalent of alumina. These mixtures, however, proved to be less fusible than felspar, and their fusing point rose with a decreasing percentage of silica and alumina. The addition of kaolin or quartz raises the fusing point of felspar, whereas the simultaneous addition of lime and kaolin diminishes it considerably. For the sake of the following experiments the different glazing mixtures were finely powdered, moulded in the shape of tetrahedron of 5cm. height and 2cm. edge length, fastened to a fire-clay plate, and exposed to a heat equal to that of fusing felspar. Table I. shows the result ; the first group contains felspar and quartz in the proportion of their equivalents as 1 to 6 ; the amount of kaolin is varied and rises half an equivalent every time. In the three following groups the proportion between felspar, quartz, and kaolin remains the same, but an addition of one, two, and three equivalents of calcium carbonate is made. The groups 5 to 8 contain 12 equivalents of silica.

TABLE 1.

(The mark * denotes the most easily fusible mixture of each group.)

No.	FUSING MIXTURE CONSISTS OF				CORRESPONDING WITH				REMARKS.
	Felspar equivalent to 2735.	Quartz equivalent to 30.	Kaolin equivalent to 1295.	Marble equivalent to 50.	K ₂ O.	CaO.	Al ₂ O ₃ .	SiO ₂ .	
1	1	6	—	—	1	—	1	12	None of the cones in this group were fused, but the cone 1c had, after heating, a porcelain-like appearance.
1a	1	6	0.5	—	1	—	1.5	13	
1b	1	6	1.0	—	1	—	2.0	14	
1c	1	6	1.5	—	1	—	2.5	15	
2	1	6	—	1	0.5	0.5	0.5	6.0	Fused to a round bead.
2a	1	6	0.5	1	0.5	0.5	0.75	6.5	
2b	1	6	1.0	1	0.5	0.5	1.0	7.0	
2c	1	6	1.5	1	0.5	0.5	1.25	7.5	
3	1	6	—	2	0.33	0.66	0.33	4.0	Fused, but the original shape is still distinguishable; disposed to devitrification.
3a	1	6	0.5	2	0.33	0.66	0.5	4.33	
3b	1	6	1.0	2	0.33	0.66	0.66	4.66	
3c	1	6	1.5	2	0.33	0.66	0.83	5.0	
4	1	6	—	3	0.25	0.75	0.25	3.0	Partly fused.
4a	1	6	0.5	3	0.25	0.75	0.38	3.25	Fused to a bead; disposed to devitrification.
*4b	1	6	1.0	3	0.25	0.75	0.50	3.50	Fused.
4c	1	6	1.5	3	0.25	0.75	0.63	3.75	Fused; disposed to a devitrification
5	1	12	—	—	1	—	1	18	None of the cones were fused; but they showed a porcelain-like appearance, No. 5 being glazed best of all.
5a	1	12	0.5	—	1	—	1.5	19	
5b	1	12	1.0	—	1	—	2.0	20	
5c	1	12	1.5	—	1	—	2.5	21	
6	1	12	—	1	0.5	0.5	0.5	9	Fused, original shape is still distinguishable.
*6a	1	12	0.5	1	0.5	0.5	0.75	9.5	Fused to a bead.
6b	1	12	1.0	1	0.5	0.5	1.0	10	Partly fused.
6c	1	12	1.5	1	0.5	0.5	1.25	10.5	Only fused at the top.
7	1	12	—	2	0.33	0.66	0.33	6.0	Fused, original shape still distinguishable
7a	1	12	0.5	2	0.33	0.66	0.50	6.33	Fused to a round bead.
*7b	1	12	1.0	2	0.33	0.66	0.66	6.66	
7c	1	12	1.5	2	0.33	0.66	0.83	7.0	
8	1	12	—	3	0.25	0.75	0.25	4.5	All the cones of this group easily fused to a round bead.
8a	1	12	0.5	3	0.25	0.75	0.38	4.75	
*8b	1	12	1.0	3	0.25	0.75	0.50	5.0	
8c	1	12	1.5	3	0.25	0.75	0.63	5.25	

We learn from these experiments that a glazing mixture will fuse easily, if there be a certain and definite proportion of alumina and alkaline flux present. This fact becomes still more evident in Table II. of experiments, where mixtures were prepared with a constant quantity of flux ($0.2K_2O$ and $0.8CaO$) and uniformly increasing percentage of silica and alumina:—

TABLE II.

(The mark * denotes the most easily fusing mixture of each group.)

No.	($RO=0.2K_2O+0.8CaO$)	REMARKS.
8	$RO, 0.2 Al_2O_3, 2 SiO_2$	This group is less fusible than the corresponding members of the next group.
9a	$RO, 0.3 Al_2O_3, 2 SiO_2$	
9b	$RO, 0.4 Al_2O_3, 2 SiO_2$	
*9c	$RO, 0.5 Al_2O_3, 2 SiO_2$	
9d	$RO, 0.6 Al_2O_3, 2 SiO_2$	This group is more easily fusible than the previous, but less fusible than the following.
10	$RO, 0.2 Al_2O_3, 3 SiO_2$	
10a	$RO, 0.3 Al_2O_3, 3 SiO_2$	
10b	$RO, 0.4 Al_2O_3, 3 SiO_2$	
*10c	$RO, 0.5 Al_2O_3, 3 SiO_2$	This group is still more easily fusible.
10d	$RO, 0.6 Al_2O_3, 3 SiO_2$	
11	$RO, 0.2 Al_2O_3, 4 SiO_2$	
11a	$RO, 0.3 Al_2O_3, 4 SiO_2$	
11b	$RO, 0.4 Al_2O_3, 4 SiO_2$	This group is less fusible than the mixtures of the previous groups. There is no perceptible difference in the fusibility of No. 12c and 12d.
*11c	$RO, 0.5 Al_2O_3, 4 SiO_2$	
11d	$RO, 0.6 Al_2O_3, 4 SiO_2$	
12	$RO, 0.2 Al_2O_3, 5 SiO_2$	
12a	$RO, 0.3 Al_2O_3, 5 SiO_2$	This group is still less fusible than the preceding group. No. 13c and 13d fused at the same time.
12b	$RO, 0.4 Al_2O_3, 5 SiO_2$	
*12c	$RO, 0.5 Al_2O_3, 5 SiO_2$	
12d	$RO, 0.6 Al_2O_3, 5 SiO_2$	
13	$RO, 0.2 Al_2O_3, 6 SiO_2$	
13a	$RO, 0.3 Al_2O_3, 6 SiO_2$	
13b	$RO, 0.4 Al_2O_3, 6 SiO_2$	
*13c	$RO, 0.5 Al_2O_3, 6 SiO_2$	
*13d	$RO, 0.6 Al_2O_3, 6 SiO_2$	

It was then tried to make glazing mixtures still more easily fusible by partly replacing alumina by iron peroxide. The result is, indeed, a more easily fusible mass, as long as no more than $0.2 Fe_2O_3$ is added. A greater amount of iron peroxide causes devitrification. On the other hand, the glaze becomes less fusible by an addition of alumina and silica. Starting from these facts and keeping in view the results of the previous experiments, the standard cones which were to serve as a scale of heat were prepared from the mixtures given on next column, and ranging in their chemical composition between $0.3 K_2O, 0.7 CaO, 0.2 Fe_2O_3, 0.3 Al_2O_3, 4 SiO_2$ and $0.3 K_2O, 0.7 CaO, 3.9 Al_2O_3, 39 SiO_2$.

By the fusion of these cones the temperature between $1145^{\circ}C.$, and the highest heat of the pottery oven can be measured. Taking this difference of temperature as $600^{\circ}C.$, the fusion of each successive cone indicates a rise of $30^{\circ}C.$ The Royal Porcelain Works of Berlin—Königl. Porzellanmanufaktur—sells one hundred of these cones at 4s. 6d.

No.	Chemical Formula: $0.3 K_2O, 0.7 CaO,$ and—	Corresponding to 33.55 parts Fe spar, 53 parts Marble, and—
1.	$0.2 Fe_2O_3, 0.3 Al_2O_3, 4 SiO_2$	Quartz 66.0 Fe_2O_3 16.0
2.	$0.1 Fe_2O_3, 0.4 Al_2O_3, 4 SiO_2$	Quartz 60.0 Fe_2O_3 8.0 Kaolin 12.95
3.	$0.05 Fe_2O_3, 0.45 Al_2O_3, 4 SiO_2$	Quartz 57.0 Fe_2O_3 4.0 Kaolin 19.13
4.	$0.5 Al_2O_3, 4 SiO_2$	Quartz 51.0 Kaolin 25.9
5.	$0.5 Al_2O_3, 5 SiO_2$	Quartz 84.0 Kaolin 25.9
6.	$0.6 Al_2O_3, 6 SiO_2$	Quartz 108.0 Kaolin 38.85
7.	$0.7 Al_2O_3, 7 SiO_2$	Quartz 132.0 Kaolin 51.8
8.	$0.8 Al_2O_3, 8 SiO_2$	Quartz 156.0 Kaolin 64.75
9.	$0.9 Al_2O_3, 9 SiO_2$	Quartz 180.0 Kaolin 77.7
10.	$1.0 Al_2O_3, 10 SiO_2$	Quartz 204.0 Kaolin 90.65
11.	$1.2 Al_2O_3, 12 SiO_2$	Quartz 252.0 Kaolin 116.55
12.	$1.4 Al_2O_3, 14 SiO_2$	Quartz 300.0 Kaolin 142.45
13.	$1.6 Al_2O_3, 16 SiO_2$	Quartz 348.0 Kaolin 168.35
14.	$1.8 Al_2O_3, 18 SiO_2$	Quartz 396.0 Kaolin 194.25
15.	$2.1 Al_2O_3, 21 SiO_2$	Quartz 468.0 Kaolin 233.10
16.	$2.4 Al_2O_3, 24 SiO_2$	Quartz 540.0 Kaolin 271.95
17.	$2.7 Al_2O_3, 27 SiO_2$	Quartz 612.0 Kaolin 310.8
18.	$3.1 Al_2O_3, 31 SiO_2$	Quartz 708.0 Kaolin 362.6
19.	$3.5 Al_2O_3, 35 SiO_2$	Quartz 804.0 Kaolin 414.4
20.	$3.9 Al_2O_3, 39 SiO_2$	Quartz 900.0 Kaolin 466.2

—S. II.

A New or Improved Method of Glazing China, Porcelain, Earthenware, and Parian. Henry Venables, Linthorpe, Middlesbro'. Eng. Pat. 11,084, September 18, 1885. 6d.

AFTER describing the character of the "soft" glaze appropriate to the detailed operations, the object and claim of the inventor is to glaze ceramic articles by immersing them while in a heated state in heated molten or liquid glaze.—T.

Improvements in the Manufacture of Glass and Articles therefrom. Fred. Stacey Shirley, New Bedford, Massachusetts, U.S.A. Eng. Pat. 8023, June 16, 1886. 8d.

THE patentee relies upon the power which gold, under the influence of varying degrees of heat, has, in combination with certain metallic oxides and salts, such, and principally as, uranium oxide, chromium oxide, copper carbonate, etc., to produce various and remarkable shades of colour. Opalescence, complete or partial, is

produced in the usual way, but gradations of shade, lines, streaks, etc., are produced by partial surface and local heating. The presence of alumina seems to be a necessary element in the production, in the presence of gold, of the translucent and peculiarly coloured glass, which, together with its ornamental treatment, are the subject of this patent.—T.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Hardening of Cements. L. C. Levoir. Rec. des Trav. Chim. 5, 59.

HAVING previously shown (*Chem. Zeit.* 9, 818) that aluminates cannot be the cause of the hardening of cements, further researches lead the author to assume that the hardening is caused by crystallisation. He believes that after Portland cement has been ground and burnt, each grain is split in the air, attracts moisture to a small extent, and is covered with carbonate of lime and gelatinous silicic acid, which after about a month becomes crystalline, the change taking place more rapidly in summer. This explanation of the hardening of Portland cement will also account for the same phenomena in the case of hydraulic lime. The volcanic tufts (trass) contain only half a per cent. of silicic acid, soluble in hydrochloric acid, but corresponding hydrated silicic acids yield, with lime, a hydrated calcium silicate from which the carbonic acid of the air eliminates silicic acid, first in the gelatinous, but finally changing to the crystalline state.—A. R.

On the Influence of Frost on Portland Cement mixed with Slag. Bohme. Mittheil. a. d. Kgl. Techn. Versuchsanstalten zu Berlin, 4, 50.

THE experiments described were undertaken at the request of the Minister of Public Works. It was found that unmixed cements of normal specific gravity (3.099, 3.106, 3.115, 3.125, 3.115) withstood the action of frost, while those of low specific gravity (3.030, 2.617, 3.058, 3.077, 3.030, 3.086) did not. Only one cement of low specific gravity (3.040) unmixed with slag withstood the test. Of those cements which, when prepared from the ordinary materials, withstood the action of frost, only one—of specific gravity 3.099—was improved in this respect by the addition of 30 per cent. of slag. All the rest, and especially those of low specific gravity, were weakened thereby.—S. Y.

On the Influence of Magnesia in Portland Cement. G. Lechartier. Compt. Rend. 102, 1223.

THE author has had a great many opportunities for observing the changes which a certain cement underwent that had been employed for reservoirs, foundation walls, etc. The cement was a well-burnt Portland cement of apparently good quality, and the work was executed perfectly. Though very hard and solid at first, after one or more years the cement was disintegrated, the volume increasing at the same time. The latter was accompanied by a great development of force; the individual pieces retained considerable hardness. Several specimens of cements used for the above purposes were analysed. One gave—

SiO_2 17.42%, Al_2O_3 + Fe_2O_3 9.82%, CaO 43.56%, MgO 29.18%.

In all cases the percentage of magnesia exceeded twelve, while most Portland cements usually only contain very small quantities of magnesia. As St. Claire-Deville has shown, free magnesia can unite with water to form a hard hydrate, an increase of volume taking place simultaneously. This hydration only occurs after prolonged action of the water, in case the magnesia has been burnt at high temperatures. Thus, the phenomena observed by the author are readily explained, for the Portland cements above referred to had been obtained from dolomitic marl, and therefore naturally contained magnesia which was gradually hydrated, and as this also means an increase in volume, the buildings, etc.,

were destroyed. A corroboration of the fact that this is indeed the probable cause, may be gathered from the observation, that the cement was changed the more rapidly the better the water had access to the mass, and that the quantity of the water contained in the cement increased the further this disintegration proceeded.

—A. R.

Notes on the Nature of the Hardening Process in Cement. E. Michel. Journ. Prakt. Chem. 33, 548.

THE author describes experiments undertaken with the object of ascertaining the influence of the lime, silica, and alumina respectively on the hardening of cement. Mixtures of gelatinous silica and pure lime hardened in all cases, but the hardness depended on the amount of lime, on the thoroughness of the mixture, and on the quantity of water present. A moistened mixture of gelatinous silica dried at 110° and of finely divided calcium hydrate became very hard after fourteen days. A mixture of alumina, dried at 110°, with lime forms a cement, but gelatinous or ignited alumina gave negative results unless the mixture was placed in a filter-paper cartridge and immersed in water, when hardening rapidly took place in all cases; the reaction took place more rapidly than with silica, but the cements were not so hard. Mixtures of silica and alumina do not form cements. The lime plays a double part in the hardening of cement; it combines with the silica and alumina, and by the formation of calcium carbonate it forms a protective layer. It was found that the amount of lime which enters into combination is very small, and greater hardness was obtained by employing smaller quantities of lime than are generally present in Portland cements. In a hardened lime-silica cement the amount of combination was ascertained by dissolving the calcium carbonate and free lime in ammonium chloride, and then the calcium silicate in hydrochloric acid. In the case of lime-alumina cements the aluminate was present in the residue from the ammonium chloride. It was found that lime-silica cement contained about 5 per cent. of silicate, lime-alumina cements about 2.5 per cent. of aluminate, and Portland cements about 7.5 per cent. of silicate and aluminate. The compounds appear to be formed only on the surface of the particles of cement, which are thus held together. Alkalis do not produce hardening.

—S. Y.

Improvements in Apparatus for Impregnating Wood with Preservative and other Fluids. W. R. Lake, Middlesex. From J. Plister. E. Durst, and Dr. L. Vidrie, Agram. Eng. Pat. 12,844, October 26, 1885. 5d.

THIS apparatus is chiefly designed for impregnating freshly-felled or dried trunks of trees, of any size, with a preservative fluid. It consists of a hollow cap, provided with a sharp cutting edge and a nozzle for the attachment of a hydraulic force pump; it is fixed on the larger end of the log by means of a cross bar held in position by two bolts, the other ends of which are cramped into the log. The liquid is forced into the cap under pressure by means of a pump until the trunk is thoroughly impregnated or saturated.—C. C. H.

X.—METALLURGY, Etc.

Treatment and Utilisation of Slag. Dingl. Polyt. J. 260, 471—473.

ACCORDING to Hoyermann (*Sitzungsberichte des Vereins zur Beförderung des Gewerbefleisses*, 1885, 234) the slag obtained at Peine in dephosphorising the pig iron contains—

P_2O_5	MgO.	Fe.	Mn.	SiO_2	CaO.	Si.
20	5	11	2	6	50	1

The phosphoric acid is combined with the lime as tricalcium phosphate. This slag is very suitable for manuring purposes, owing to the fact that the calcium phosphate is in intimate combination with substances which are readily decomposed by water. This explains

the circumstance that the slag (even the largest pieces) is gradually reduced to powder on exposure to the air.

Referring to the difficulty experienced in removing the particles of iron contained in basic slag (Thomas' slag) before grinding it, Horn (*Berg. und Hüttenm. Zeit.* 1886, 40) suggests the following mode of procedure. The slag is first broken up in stamping mills or by means of stone hammers. The large pieces of iron are then picked out, and the remainder is subjected to the action of powerful rolling or crushing mills. By this means the metal remaining in the slag is flattened without damaging the surface of the rollers. In order to separate the iron from the pulverised slag, the mass may be passed through a sloping sieve similar in construction to that devised by Nagel and Kaemp.

According to Hohlleiss (*Zeitschr. des Landwirthschaftlichen Vereins der Provinz Sachsen*, 1885, 264) phosphatic meal from Peine contains—

	I.	II.
Phosphoric acid soluble in		
citrate	274 per cent.	381 per cent.
Total phosphoric acid ..	17.65	19.37

It is recommended for soils rich in humus.—D. B.

Some New Investigations and Theories on the State of Carbon in Iron and Steel. A. Ledebur. *Stahl und Eisen*, 6, 374, 380.

THE author reviews the theories of Sir Frederick Abel, and of Osmund and Werth, and describes his own researches on this subject. Abel states that when steel is treated with potassium permanganate and dilute sulphuric acid, a carbide Fe_3C is left behind, and concludes that in strongly heated and in cold rolled steel the carbon is almost entirely present in the form of this carbide, that it is not present in red-hot or fused steel, and that its formation is prevented by rapid cooling. Osmund and Werth have examined steel, and also the residue left after solution, microscopically, and arrive at practically the same conclusions as regards slowly and rapidly cooled steel. They state that if the quantity of carbon set free by the dissociation of the carbide when steel or iron is heated, is too great to allow of its complete solution in the iron, it is found to be present as graphite. They have observed the presence of graphite in steel as well as in grey iron. The author's researches confirm those of Forquignon as regards the elimination of carbon from pig-iron by long-continued ignition in absence of air, the iron being surrounded by some indifferent body, such as sand, or even wood charcoal. In one experiment a piece of white cast-iron and of wrought-iron were heated together in wood charcoal. After heating, the former contained less, and the latter more carbon than at first. That the loss of carbon is not due to oxidation was proved by the absence of carbon monoxide or dioxide in the liberated gases, and the author considers that it is due to the formation of volatile hydrocarbons. This view is supported by the fact observed by Forquignon, that pig-iron loses a large quantity of carbon when heated in a current of hydrogen. It appears that at first the other forms of carbon are converted into graphite, and that this is afterwards eliminated. The presence of manganese retards the decomposition of the carbide or iron-carbon alloy, and therefore the formation of graphite. Silicon, if not present in sufficient quantity to cause the conversion of white into grey iron, appears to be favourable to the elimination of carbon.—S. Y.

Durability of Steel Rails. Ch. P. Sandberg. *Revue Industrielle*, 19, 160.

BESIDES depending on their section, the durability of steel rails is greatly influenced by their chemical composition. A specimen containing 0.3 per cent. of carbon is too soft, if only small quantities of sulphur and phosphorus are present. In case the amount of phosphorus reaches 0.1 per cent., the percentage of carbon should not exceed 0.3 per cent., especially in cold regions. Dr. Dudley recommends a limit of 0.4 per cent. of silicon, but steel containing 0.1 per cent. is good enough to resist most actions which the rails are exposed to, assuming

phosphorus to be present in small quantity. Hard steel is preferable to soft steel, and it may be taken for granted that steel free from sulphur and phosphorus, but containing 0.5 per cent. of carbon, is the best for rails. As compared with iron rails, it was found that steel rails may be used nine times longer than the latter, but for calculations the durability of steel rails may be assumed to be three times that of iron rails.—A. R.

Thallium in Commercial Zinc. Dr. Kosmann. *Chem. Zeit.* 10, 762.

IN some commercial zinc obtained by melting up refuse zinc, the author found comparatively large quantities of thallium, while that rare metal has been hitherto only found in very small quantities in zinc ores. The fracture of the zinc was somewhat uneven, and in the leafy and silvery part short streaks of a grey colour and granular structure were embedded. It was found to contain a large quantity of lead and arsenic, some cadmium, iron, manganese, alumina, and as much as 1.4 per cent. of thallium.—A. R.

Action of Milk of Lime on certain Metals and Alloys. T. Schmelzer, jun. *Chem. Zeit.* 10, 763.

THE author has examined the extent to which different metals are attacked by milk of lime. Pure soft lead is attacked considerably, regulus of antimony remains entirely unchanged, lead tubing containing 25 per cent. of "hard lead" (Hart-blei) is slightly changed, lead plate or brass is fairly attacked, pure pig-iron being strongly corroded; on phosphor-bronze no action could be observed, and it was only very slight in the case of tin. It therefore appears that pumps which are to resist the action of milk of lime should be made of phosphor-bronze, or of an alloy of tin and antimony.—A. R.

Improvements relating to the Separation of Tin from Tinplate, and to the Production of Protochloride of Tin. H. H. Lake, Southampton Buildings. *Eng. Pat.* 10,018, August 24, 1885. 4d.

THE scrap is heated to 400° C., in hydrochloric acid gas, the resulting stannous chloride being afterwards condensed and utilised as desired.—W. G. M.

Improvements in Machinery for the Reduction of Tin Stuff and other partially-pulverised Ores, to extract the Metal therefrom, as well as for Grinding Paint, Cement, and other Hard Substances. S. H. Stephens and S. Rodda, Illogan, Cornwall. *Eng. Pat.* 10,119 August 26, 1885. 5d.

A RECTANGULAR and inclined rubbing bed is used, having medially from end to end a series of transverse rectangular troughs, each extending one-third of the total width of the bed; between each pair are perforations. On either side of this central band are placed parallel troughs, similar, but fixed at an angle with the others; these serve to direct the material under treatment to the centre of the bed. The rubber consists of several transversely placed plates, the right and left wings of which form an angle corresponding to that of the troughs: these plates are fixed to an iron strap, by means of which the necessary reciprocating motion is communicated; the front edge of the plates is bevelled inwards. The ore is fed by means of a launder placed at one end, the crushed material being delivered at the other.—W. G. M.

Recovering Tin from Waste Tinned Iron. W. Beatson, Rotherham. *Eng. Pat.* 11,067, Sept. 18, 1885. 6d.

THE scrap, cut into small pieces, is placed in a cylinder of iron-wire gauze with sheet iron ends, and mounted on an iron axle, or into iron gauze boxes of rectangular shape, and is therein made the anode to a galvanic current passing through a bath of boiling caustic soda and potassium cyanide. The cathode, upon which the dis-

solved tin is redeposited, may consist of iron plates in motion or at rest, of slowly-revolving wheels which will compress the loose deposit, or of the walls of the containing tank itself.—W. G. M.

Improvements in Means or Apparatus employed in Coating Metal Plates with Tin, Ferroc, or other Metals or Alloys. D. Davis, Morriston, Glamorgan. Eng. Pat. 11,280, September 22, 1885. 8d.

THIS patent deals with the passage of the tinned plates through rollers working in grease. Each plate is placed in a cradle and brought mechanically into position beneath a double pair of rollers; the cradle is then raised by a lever until the plate is gripped by the rolls. Two pairs of these double rolls are employed, the mechanism for raising the cradle being actuated in each alternately.—W. G. M.

Process and Means for Soldering Aluminium. J. S. Sellon, Hatton Garden. Eng. Pat. 11,499, Sept. 26, 1885. 6d.

THE aluminium surfaces, cleaned by scraping, are covered with a layer of paraffin wax as a flux, and are then coated by fusion with a layer of a zinc-tin-lead alloy (preferably in the proportion of 5:2:1). The metal so prepared may be soldered in the usual way.—W. G. M.

Improvements in Machinery or Apparatus for use in Pickling and Swilling Metal Plates. R. Evans, Landore. Eng. Pat. 11,753, October 2, 1885. 8d.

THE cradles containing the plates are suspended by rods attached by double rocking bearings to the arms of the supporting cylinder, so that when immersed in the pickling or washing vat an oscillating motion is imparted to them with the aid of a V-lever, actuated by suitable machinery.—W. G. M.

An Improvement in the Process of Extracting Wrought-Iron and Steel directly from Ores. O. Imray, Southampton Buildings. Eng. Pat. 11,798, October 3, 1885. 8d.

THE ore, if necessary buddled and roasted, is mixed with suitable fluxes and heated on the hearth of a regenerative gas furnace to the reduction temperature of oxide of iron; all air is then carefully excluded, and the charge heated to complete reduction in the combustible gases alone; this end attained, air is again admitted, and the temperature raised to the fusing-point of the metal and slag. Carburisation to the required degree is effected by the addition of pig-iron, or of carbonaceous material immediately before tapping. The gas regenerator should be of greater capacity than that used for the air.—W. G. M.

Improvements in the Treatment of Auriferous and Antioargentiferous Minerals. S. Pitt, Sutton. Eng. Pat. 12,909, October 27, 1885. 8d.

IN a semi-cylindrical horizontal trough is a long open framework agitator, to which motion is imparted by an axial spindle actuated by an external handle; this heater, arranged so as to almost touch the bottom of the tank at any point, is kept slowly oscillating to and fro, and thus serves to maintain the contents of the latter in constant but gentle agitation. The ore must be uniformly crushed, and, if necessary, roasted; it is then introduced, with much water and a little mercury, into the trough, where it is kept in constant slow movement for from three to six hours, during which time the heavier particles will sink to the bottom, and there become amalgamated. The contents of the trough are removed carefully through a sliding door at the end of the vessel, the tailings being allowed to run to waste, the heavier portions being washed, and the amalgam distilled. The depth of water in the cylinder will vary from 60cm. to 1m.—W. G. M.

An Improved Metallic Alloy. J. Webster, Birmingham. Eng. Pat. 8320, June 23, 1886. 4d.

A NON-OXIDISABLE ALLOY, of high tenacity, durability, and capacity for vibration, and susceptible of polish, is made by alloying copper 200lb., tin 80lb., aluminium and bismuth, each 10lb., and adding the ingots so produced in the proportion of 4½lb. to copper 164lb., nickel 70lb., and zinc 61½lb. With this is to be used the flux described in Eng. Pat. 12,344, 1885.—W. G. M.

Improvements in and connected with Refractory Linings, particularly adapted for Metallurgical Furnaces, but applicable also for other Purposes. T. Twynam, Kensington. Eng. Pat. 8358, June 24, 1886. 4d.

TO prevent the crumbling of the chrome iron ore lining which occurs if it be prepared with water, oil, or tar alone, it is mixed with 5 per cent. of chromate or bichromate of an alkali or alkaline earth previously dissolved in the water used to render the mass plastic, and made into bricks, or rammed as usual.—W. G. M.

XI.—FATS OILS, AND SOAP MANUFACTURE.

Examination of Oil. T. Morawski. Dingl. Polyt. J. 260, 512–514.

FINKENER (*Ibid.* 260, 431) has recently described a method of estimating mineral oils in fatty oils, which is based on the assumption that the amount of unsaponifiable fat may be determined by the quantity of alkali required to saponify the oil. It is supposed that fatty oils require 19 per cent. of potassium hydrate to completely saponify them. According to the view entertained by the author, this assumption is perfectly erroneous, and the method suggested by Finkener without utility, Kottstoefer (*Ibid.* 232, 286). Allen (*Chem. News*, 43, 267), and Valenta (*Ibid.* 249, 270), having shown that different oils require different quantities of alkali for saponification. The simplest and most accurate methods for estimating oils containing unsaponifiable fats are those of Nitsche (this Journal, 1884, 322), and Morawski and Demski (this Journal, 1886, 179).—D. B.

On the Oxidation of Oils. Ach. Livache. Compt. Rend. 102, 1167.

ACCORDING to a previous communication of the author (*Chem. Zeit.* 9, 1695), the drying up of oils, which is due to a rapid absorption of oxygen, may be accelerated by introducing certain metals, particularly lead and manganese. The best way is to treat the oil with a mixture of finely-divided lead and manganese nitrate, the latter being readily soluble in oil. After decanting, some lead oxide is added to decompose excess of manganese nitrate. Thin layers of linseed oil which have been treated thus dry in less than four hours. A number of other oils, both drying and non-drying, were subjected to the same treatment, and the changes which they underwent when exposed to the air were observed for two years. It was found that oxygen, which converts the drying oils into hard products and turns the non-drying oils rancid, converts a portion of the insoluble fatty acids into soluble ones, the acids with higher molecular weight finally decomposing and forming homologous acids with a lower molecular weight. After two years, the non-drying oils resemble, both in appearance and composition, the products obtained by the hardening of certain drying oils during one year. This relatively slow change which is brought about in the drying oils probably takes place more speedily if a large amount of oxygen can be provided.—A. R.

Refining of Heavy Lubricating Oils. Fr. Recl. Chem. Zeit. 10, 760.

THE chemical composition of certain naphtha oils found in Roumania is identical with that of the oils from Baku, and the residues from both contain the same amount of

fatty matter, and are, moreover, of similar consistency; but the lubricating oil from the former has the higher specific gravity, and the heavy fractions contain a comparatively larger quantity of the saponifiable products than are found in the Baku oils. The author says the safest way of preventing saponification is to prevent agitation during the neutralising period, and he gives a detailed description of the apparatus and method used. If the oil is washed entirely free from acid, it is saponified even before adding caustic soda. Aluminium hydrate is recommended for freeing the oil of finely-divided and suspended charcoal. This hydrate, especially when prepared from bauxite, is excellent for bleaching or clearing mineral oils, but its high price excludes its employment on a very large scale, and it will therefore hardly replace the cheap "bleaching powder" of the prussiate of potash works. The method of saponification used in kerosin works the author has found to be most disadvantageous.—A. R.

Preparation of Soap. F. Eichbaum. Seifenfabrikant, 1886, 102.

IN order to make a soap from strongly-smelling fish fats, the author takes 400kilos. of the fat, 25kilos. raw palm oil, 250kilos. lye, 12° B., and warms up. A further similar amount of lye of 15° B. is added, and the thoroughly-mixed mass allowed to boil till clear and free from scum, more lye being added, as much as necessary. The mass is then poured in a thin stream through 20-degree lye, 50kilos. powdered rosin are added by degrees, and then 40kilos. 20-degree lye, and the mass boiled. When ready the soap is salted out in the ordinary way. The addition of the rosin causes the fishy smell to be remarkably lessened.—B. H.

XII.—PAINTS, VARNISHES, AND RESINS.

An Improved Waterproof and Anti-corrosive Composition suitable for Coating Ships' Bottoms, and such like Purposes. Edwin Lewis Kitchingman, Collingwood, Victoria; and Arthur Andrews, Albury, N.S.W. Eng. Pat. 11,529, September 28, 1885. 6d.

THE composition is made by heating tar (2½lb.) in a suitable vessel to just the boiling point, then gradually adding oxide of iron (2lb.). Rosin (1oz.) is then added, and when the rosin is dissolved sugar of lead (2oz.) is added. The composition can be used hot or cold. If used cold it must be dissolved in a suitable quantity of shellac varnish.—B. H.

An Anti-fouling Composition for Protecting and Preserving Ships' Bottoms and other Submerged Surfaces, applicable also for Coating Metal, Wood and other Underground Surfaces. George Washington Carr and James Dickinson, both of Fleetwood. Eng. Pat. 11,543, September 28, 1885. 4d.

THE composition consists of 100 parts resin, 31 parts bisulphide of carbon, 3 parts powdered lime, 19 parts paint, or other colouring matter, and 18 parts naphtha. The patentees state in their final specification that in practice they prefer to omit the powdered lime.—B. H.

Improvements in the Process or Manner of Manufacturing Caoutchouc, Wax, Fat, Colouring Matter, Vegetable Fibre, Fibre Wool, and Cattle Food, from Lactucarious Plants, or from Plants bearing Milky Juice, or from their Extracts, such as Opium, Lacina, and their likes. George Kassner, Breslau, Germany. Eng. Pat. 11,561, September 29, 1885. 6d.

MOST of the plants with a milky juice contain caoutchouc. By the inventor's process the respective green plants or parts of plants, or extracts from them, are dried thoroughly and reduced to powder. If the plants contain valuable fibres, these are separated from the powder. The dry powder is extracted in a suitable extractor with benzine, "sulphite of carbon" (*sic*, probably for bisulphide of carbon), chloroform or such

mixtures with alcohol. The solution is then run off and the solvent evaporated. The caoutchouc with fat, wax, and colouring matter thus obtained, is then treated with boiling alcohol, and then with alcoholic potash or soda. The raw caoutchouc thus separated from the fat, wax, and colouring matter is purified by resolution in chloroform, etc. The plant powder, after the extraction with benzine, etc., is freed from the remainder of the solvent and pressed into cakes by suitable means, forming a cattle food. If the plant powder contain valuable matters, such as alkaloid, resins, etc., or poisonous matters, these are extracted by alcohol before the treatment of the plant with benzine, etc., and worked up from the alcoholic extract.—B. H.

Improved Means of Dissolving Vulcanised Indiarubber and Indiarubber Compounds. John Bagnall, Manchester. Eng. Pat. 11,671, October 1, 1885. 6d.

THIS invention consists in utilising ercosote oils either alone or in conjunction with other oils, or the ordinary solvents of raw indiarubber.—B. H.

XIII.—TANNING, LEATHER, GLUE, AND SIZE.

The Examination of Tannin Extracts. F. Simand and E. Weiss. Dingl. Polyt. J. 260, 564—568.

HIDE POWDER, essential to the estimation of tannin by this process, is prepared by taking fresh skin, washing, unhairing, treating with dilute hydrochloric acid, stretching and drying; the skin is then planed fine, dried, and worked through a fine sieve. The watery residue from 5grms. of this powder gives only 36mgrms. dry residue, containing 5mgrms. ash. The amount of water in extracts is determined, on 2—3grms., by drying in a platinum dish in a water-bath. The ash is estimated by incinerating the residue. 12—16grms. in the case of solid, 22—28grms. in the case of fluid extracts, are dissolved, and the solution made up to 1 litre and filtered clear; 100cc. of the clear solution are evaporated, dried, and weighed, giving the total soluble matter. It is not advisable to determine the insoluble matter directly. To estimate the non-tannin matter, 250cc. of the tannin solution are put into a dry flask with 1grm. of the hide powder and shaken for several hours and then filtered into another flask. The treatment of the solution with 1grm. hide powder is twice repeated. The fourth time, 2grms. hide powder are taken. This quantity (5grms.) is in most cases quite sufficient to extract all tanning matter, 100cc. of the filtrate are evaporated to dryness and dried, the residue being the non-tannin matter. The authors state this process is more exact than Löwenthal's.

The authors give a table of results. They also state that bark extracts contain more ash than wood extracts, the ash, in the case of bark, containing a distinct quantity of manganese, wood extracts only a trace.—B. H.

Remarks on the Orpiment of Commerce and the Removal of Hair from Hides. Terreil. Bull. Soc. Chim. 484—487.

ARSENIC SULPHIDE of the trade contains 0.2 to 3 per cent. non-volatile constituents, such as calcium and iron sulphide, clay or quartz. Samples of Spanish origin sometimes contain small quantities of mercury sulphide. Arsenic trioxide is always present. If, after the removal of the hair, black spots appear on the skin, they are caused by the contact of the skin with rusty iron.—S. H.

The Manufacture of an Improved Material to be used as a Substitute for Leather, and for other Purposes. George Frederick Redfern, London. From Alfred Buckingham, Brussels. Eng. Pat. 8626, July 16, 1885. 4d.

THIS invention relates to the manufacture of a waterproof material (called by the inventor "Cuirette") from leather boards by treatment of them with forms or dies, presses or sawing machinery, and subsequent varnishing,

lacquering or colouring with alcoholic or other suitable varnishes or colours. The improved material can be used for decorative purposes and in the manufacture of trunks, cases, etc.—B. II.

An Improved Process for the Manufacture of Waterproof Material capable of being used as a Substitute for Binders' Leather or Cloth, and for Decorative and other Purposes. William Loyd Wise, London. From Julius Hofmeier, Vienna. Eng. Pat. 12,023, October 9, 1885. 6d.

CELLULAR MATTER, such as fibres of linen, cotton, jute, wool, silk, etc., wood cellulose and the waste from the treatment of such fibres or cellulose, in the form of paper or of woven material, is treated with a solution of albumen. The solution is prepared by making a concentrated solution of equal parts of albumen and glycerine with the necessary amount of water, and adding 10 per cent. of nitrate or sulphate of magnesia and 5 per cent. of basic borate of soda. The albumen solution is either applied superficially or the material is impregnated. The treated material is then passed over a drying cylinder, moistened on the back and pressed between heated rollers, or between the plates of a book-press. If cellulose or other fibres are mixed with the albumen solution, and the stiff but plastic substance pressed in heated moulds, a coagulum is obtained having the elasticity of leather.—B. II.

A Substitute for "Urine" or "Sig" for use in preparing Leather and Skins for Dyeing. Frederick Richard Maggs, of Yeovil, Somerset. Eng. Pat. 6041, May 4, 1886. 4d.

Two parts borate of soda, four of "subcarbonate of potash," six of powdered soap, and eight of carbonate of soda are mixed together. For use, 1lb. of "the preparation" is dissolved in 6galls. water and the leather or skin is immersed in or brushed over with the solution.—B. II.

XIV.—AGRICULTURE, MANURES, Etc.

On the Presence of Copper in Different Organs of Vines Treated with Lime and Sulphate of Copper to Protect them against Mildew. A. Millardet and U. Gayon. Bied. Centr. 15, 336.

THE authors have sought to determine whether copper is taken up by vines treated with a mixture of caustic lime and sulphate of copper, and, if so, to what extent by different parts of the plant. By incinerating the organs and the solid residues of the must and wine, separating the copper by electrolysis, and finally determining colorimetrically, it was found that the leaves at the time of harvest are richest in copper, the amounts fluctuating in different varieties, from 19 to 95mgrms. of copper per kilogramme of undried leaves; next are the pedicles, then the skins and seeds, then the stock. As regards the must, in no case was more than 2.2mgrms. of copper per litre found, and the wine contained still less, the maximum being 0.1mgrm. in 1000 litres. Experiments were also made to determine how long the copper is retained by the plant. A vine was treated with the copper mixture on July 15, and uprooted for the purpose of analysis on October 8. It was then found that the plant contained only 5 per cent. of the copper originally applied, and of this the leaves contained 3 per cent. or 20mgrms. per kilo. of undried leaves. The rainfall in September being very considerable, it would appear that the copper was washed from the leaves, for the mildew attacked the plants so vigorously that in a few days a large proportion of the leaves were cast. The authors therefore hold that if wet weather sets in from the end of July to the middle of August the vines should be treated a second time with the copper mixture, since the presence of 20mgrms. of copper per kilo. of undried leaves is not sufficient to protect the plants until the time of harvest.—W. D. B.

Destruction of the Ova of Phylloxera Bied. Centr. 15, 357.

BALEIANI recommends painting the stocks with a mixture of naphthalene, heavy oil, quicklime and water. Rouanet uses a mixture of heavy oil, tar, naphthalene, and quicklime, in the state of fine powder, applied by means of bellows to all parts of the stock. It penetrates the fissures of the bark, and destroys both the ova and young insects, should any of the latter be developed. Fandrin advises a solution of one part of ferrous sulphate in two of water, or one of cupric sulphate in five of water, the former being preferable. These attack not only the ova, but also insects upon or within the bark.

—W. D. B.

Improved Process for Converting the Waste Liquids of Rendering and like Establishments, technically termed Tank Waters, into Fertilisers and other Useful Products. J. van Ruynebeke, Chicago. Eng. Pat. 6857, May 21, 1886. 6d.

THE inventor manufactures from the waste liquids known as "tank waters," a concentrated antiseptic fertiliser free from the deliquescent and viscid properties which characterise the products generally recovered from these waste liquids. The process consists in subjecting the liquids, after evaporation, to a decomposing temperature not exceeding 260°, a brittle, easily-pulverised substance being obtained, having phenol uniformly distributed throughout its mass, while the volatile products are collected in suitable apparatus as ammonia compounds, amines, illuminating gases, aniline and carbolic tars.—D. B.

XV.—SUGAR, GUMS, STARCHES, Etc.

The Influence of Heat on the Absorbent Power of Animal Charcoal. Otto Moszeick. Arch. f. Anat. u. Physiol. 1885, 275—283.

FILHOL was the first who observed that animal charcoal absorbs more organic matter at higher temperatures than in the cold. The author found that this phenomenon can be readily shown with glucose, picrocarmine and sodium indigo-sulphonate. The circulation which is caused by the heat only partially explains this result, for the same difference in the absorption appears with samples which are shaken in the cold, or treated with animal charcoal at higher temperatures. The absorbed matter only dissolves in traces in boiling water.—S. II.

XVI.—BREWING, WINES, SPIRITS, Etc.

Method for Determining Fusel Oil in Alcohol. J. Traube. Chem. News, 53, 302—303; and Zeit. f. Spiritus Ind. 1886 [36].

AFTER reviewing the present methods for determining fusel oil in brandies, etc., all of which the author pronounces unreliable, the following method is found to give very good results. The author has demonstrated in various chemico-physical researches that the height to which aqueous solutions of organic bodies of one and the same series ascend in capillary tubes (the percentage remaining the same), often decreases very considerably with an increasing molecular weight of the dissolved body. This fact rendered it probable that even a very small percentage of fusel in brandies would betray itself by a reduction of the capillary ascent. It was known to the author from previous researches that the substances present in fusel in estimable proportions, such as the propylic and butyric alcohols, and the various aldehydes, including furfural, reduced the capillary ascent more than ethylic alcohol, but less than amyllic alcohol. It was to be expected that any differences in the composition of the fusels, or of the brandies, would have only a vanishing influence upon this method—an assumption which has been fully confirmed by experience. The apparatus and method of observation is given by the author in *Journal für Prakt. Chem.* New Series, vol. xxxi. 177, 178. A thin-walled capillary tube, as narrow as possible, is fastened to a very fine scale, divided into

half millimetres. The scale terminates at its zero in two points, which are set exactly at the surface of the liquid by means of a stand movable upon screws. The capillary tube can easily be kept clean if it is washed after every experiment with water and alcohol, and afterwards dried by forcing through it a current of air dried and purified over sulphuric acid. The liquid is sucked up in the capillary tube two or three times, and the bottom of the meniscus is read off a few seconds after the liquid has come to rest. With a little practice and observation of all precautions, it becomes readily possible to read off to $\frac{1}{10}$ mm. even without a lens. With this apparatus the author has examined a number of solutions containing from 1 to 1 per cent. by volume both of crude fusel and of pure isoamyl alcohol, dissolved in an alcohol, the specific gravity of which always corresponded to that of a 20 per cent. by volume. This is a degree of concentration very suitable for the examination of brandies. In the table compiled by the author, the capillary heights are given in millimetres. From this table it appears that the solutions of pure isoamyl alcohol, according to expectation, show a rather lower capillary ascent than the corresponding solutions of the crude fusel oils. It appears that generally $\frac{n-1}{10}$ per cent. of amyl alcohol corresponds to $\frac{n}{10}$ per cent. of crude fusel. If the proportion of fusel, as in most cases, is less than 1 per cent., it becomes possible, by reading off to $\frac{1}{10}$ mm., to determine $\frac{1}{10}$, or, in very dilute alcoholic solutions, even $\frac{1}{100}$ per cent. of fusel. The values above 0.5 per cent. fluctuate slightly for the different solutions of fusel; but these values are of no practical importance, since a brandy which contains more than about 3 per cent. of fusel is regarded as dangerous to health. In the examination of brandies by the above method, a preliminary distillation is only required when, as in the case of liqueurs, the specific gravity of the distillate differs essentially from that of the original liquid. The specific gravity is then determined by means of a Mohr's balance, and the brandy is let down to 20 per cent. (volume) by the aid of a dilution table. The capillary height, compared with that of pure 20 per cent. ethylic alcohol, shows at once the proportion of the fusel in the diluted brandy on a scale which is empirically constructed. The firm of C. Gerhardt, glass manufacturers, of Bonn, supply capillaries tested by the author, and showing directly for different temperatures the proportion of fusel in brandies diluted to 20 per cent.

—J. B. C.

Criticism of the Direct Method for the Determination of Tartaric Acid in Wine Lees and Argol. 1st Part. A. Borntrager. Zeit. Anal. Chem. 25, 327—359.

THE author investigates chiefly the method proposed by Warington, and modified by Grosjean and Klein. He shows by numerous experiments the influence of the reagents used on the solubility of acid potassium tartrate. The chief results of his investigation lead to the following procedure:—The preliminary determination of tartaric acid in the sample recommended by Warington may be, and is, omitted. Of wine lees 7.5 grms., of argols and other tartrates 3.75 grms. are taken for analysis, treated as recommended by Warington, with neutral potassium oxalate, of which an excess of from 1.5 to 3 grms. is taken, the solution neutralised with potassium hydrate, filtered, the precipitate washed, and the solution reduced to 50cc. To this solution 5 grms. potassium chloride and 3 grms. citric acid are added, precipitation started by stirring five minutes, then allowed to stand 12 hours. The precipitate of acid potassium tartrate, filtered by means of a vacuum filter, is washed with a 10 per cent. solution of potassium chloride previously saturated with acid potassium tartrate. The ordinary variations of the temperature of the laboratory at time of filtration are of little consequence. The precipitated acid potassium tartrate is then titrated with a normal solution of sodium hydrate, perfectly neutral litmus paper serving as indicator. Results, 99.5 per cent. found for 100 employed. For the numerous tables of solubility of acid potassium tartrate the original must be consulted.

Analyses of Pure 1884 Alsation Wine. C. Anthor. Zeit. Anal. Chem. 25, 359—361.

THE following results were obtained in a series of analyses of the above wines. The numbers represent grams per 100cc:—

	Free Acid.	Volatile Acid.	Tartaric Acid.	Potassium Tartrate.	Ash.	Phosphoric Acid.	Nitrogen.	Amount of Ash in Glycerol.	Pure Glycerol.
UPPER RHINE.									
St. Pelt, red	0.5893	0.0800	0	0.2600	0.2515	0.0142	0.0389	0.0603	0.0366
" white	0.5750	0.5750	0.0031	0.1530	0.2125	0.0277	0.0139	—	—
Reichenweier, Riesling	0.3900	0.5900	0.0016	0.3100	0.1671	0.0389	0.0372	0.0220	0.7137
Zellenberg, white	0.6100	0.6100	0	0.2020	0.1785	0.0253	0.0331	0.0651	0.7153
LOWER RHINE.									
Epfz., white	0.6350	0.0650	0	0.1310	0.2071	0.0180	0.0110	0.0511	0.6214
Heiligenstein (Clevner)	0.7200	0.0638	0.0162	0.3381	0.1598	0.0100	—	0.0507	0.6279
Kleeberg, red	0.3800	0.0675	0.0207	0.2100	0.1579	0.0317	0.0168	0.0502	0.6310
" white	0.3500	0.0108	0.1388	0.2900	0.1634	0.0113	—	0.0103	0.5352
St. Nabor, white	0.6500	0.0300	0.0583	0.2200	0.2193	0.0306	—	0.0105	0.5226
Oberelnheim, white	0.6550	0.0773	0	0.2920	0.1830	0.0366	0.0112	0.0378	0.6364
Schiltigheim, white	0.7100	0.0951	0.0255	0.1410	0.2020	0.0330	—	0.0308	0.5092
Sulz, white	0.7900	0.0300	0.0407	0.2210	0.1801	0.0140	—	0.0288	0.7153

The proportion of alcohol to glycerol varies between 100:9.6 and 100:7.

After deducting the total acid the extract gives a maximum of 2.155 and a minimum of 1.232, after deducting the fixed acid 2.235 and 1.295.

The ratio of ash to extract varies from 1:8.5 to 1:13.1; the phosphoric acid to the ash from 1:4 to 1:8.1.—G. H. M.

On the Estimation of Fusel Oil in Brandy and other Spirits. A. Stutzer and O. Reitmaier. Rep. Anal. Chem. 6, 335.

THE author recommends a modification of Röse's method (*Chem. Zeit.* 8, 1879; 9, 1156), which depends on the alteration of solubility of fifty per cent. alcohol in chloroform by the presence of fusel oil. A few drops of caustic potash are added to 200cc. of brandy; 160cc. of this are distilled off, and the volume of the distillate made up to 200cc. 50cc. of this are placed in a 100cc. flask, and sufficient water added from a burette to make a 30 (not 50) per cent. solution (the amount required may be found in Brix's tables), and the flask is then filled to the mark with pure thirty per cent. alcohol. Exactly 20cc. of chloroform are placed in the carefully-dried apparatus in which the solubility is to be determined, and then the 100cc. of diluted alcohol and 1cc. of sulphuric acid of specific gravity 1.286. The mixture is well shaken and allowed to settle. The apparatus is inclined so that the chloroform is transferred two or three times into the bulb and back again into the graduated tube. After a few minutes the temperature and volume of the chloroform are read, and the amount of fusel oil calculated from the following table, which gives the percentage volume of fusel oil in 50cc. of the diluted alcohol (that is to say, in the 100cc. of 30 per cent. alcohol), the temperature being 15°. The number found must be doubled in order to get the percentage volume of fusel oil in the brandy. With pure thirty per cent. alcohol at 15° the volume of chloroform is 21.4cc.

Volume increase of Chloroform.	Percentage volume of Fusel Oil.	0.01cc. increase of volume of Chloroform corresponds to volume per cent.
0.20	0.1	0.0050
0.35	0.2	0.0057
0.50	0.3	0.0060
0.65	0.4	0.0062
0.80	0.5	0.0063
0.95	0.6	0.0063
1.10	0.7	0.0064
1.25	0.8	0.0064
1.40	0.9	0.0064
1.55	1.0	0.0065

—S. Y.

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

(A) CHEMISTRY OF FOODS.

On Pasteurised Milk. J. Van Geuns. Bied. Centr. 15, 338.

THE author has made experiments with milk heated for a short time at 60° C. in Thiel's pasteurising apparatus, with a view of determining in what degree such milk differs from the non-pasteurised in respect of lactic acid formation, alteration of casein, and the development and number of micro-organisms present. The samples of pasteurised and non-pasteurised milk were kept in sterilised tubes closed with cotton wool at temperatures from 10–12° C., and determinations of lactic acid made

daily. The following table gives the lactic acid in grms. per 100 cubic centimetres of milk:—

Day.	Ordinary Milk.	Pasteurised Milk.
1	—	—
2	—	—
3	—	—
4	0.046	—
5	0.136	—
6	0.186	0.145
7	0.112	0.279
8	0.151	0.340
9	0.201	0.280

From these figures, it is apparent that pasteurising in the apparatus in question cannot prevent the lactic acid fermentation, but certainly slightly retards that change. Kept at 35–37° C. for 24 hours, both the pasteurised and ordinary milk were found to have curdled; the former in flocculi, the latter in lumps. As regards the alteration of casein and soluble albumenoids, the difference between pasteurised and natural milk does not appear to be appreciable. As regards the influence of pasteurisation upon the development of lower organisms, the author found by Koch's gelatin cultivation method that a sample of milk which contained 2½ millions of organisms capable of forming colonies per cubic centimetre previous to being passed through Thiel's apparatus, only contained 5000–9000 after pasteurisation. A small sample of milk pasteurised by the author in reagent glasses with cotton plugs, appeared when subjected to cultivation to be thoroughly sterilised, whilst the same milk (about 10 hours old) gave 10½ millions of organisms per cubic centimetre. The working of the apparatus in question would not appear to be quite satisfactory in respect of total removal of micro-organisms, hence the lactic acid fermentation is only retarded. The author throws out a suggestion as to the removal of pathogenic organisms by pasteurising instead of by actual cooking, whereby the taste of the milk is altered. On this head further experiments are being made.—W. D. B.

Comparative Experiments on the Rapid Determination of Butter in Milk by various Methods. G. Sartori. Ann. di Chimica, 1886, 158.

THE author concludes that for rapid and exact determinations Soxhlet's areometrical method gives the best results, and he recommends its use in the research laboratories; Marchand's lactobutyrometer is recommended for the use of cheese-makers, and Adam's modified method for the town authorities. The areometer gave quite trustworthy results.—S. Y.

Apple Chips containing Zinc. J. Stinde. Industrieblätter, 1886, 116.

DRIED American apple chips frequently contain zinc, the presence of which is attributed to the treatment with salt water in zinc wire buckets and the subsequent process of drying on hurdles made of zinc wire. The object of this treatment is to prevent the chips from assuming a yellow or brown colour. The whiter the colour the more essential it is to test the chips for zinc.

—D. B.

(B) SANITARY CHEMISTRY.

Contribution to the Question of the Preservation of the Purity of Water-courses. Chem. Zeit. 10, 792.

THIS paper deals with the cause of the pollution of the river Werra and the consequent injury to the town of Herford. The Corporation of Herford laid the blame on the rice starch manufactory of E. Hofmann & Co. in Salzdahlun; the proprietors of the works, however, held that the injury was caused by the damming of the river lower down by the owners of a water mill, the water being thereby rendered stagnant. The case has come before the various courts, and after further improvements in the method of purification of the water from the starch works had been adopted by the owners, and approved by

the commission appointed to consider the question, it has been decided in favour of Messrs. Hofmann & Co. The water as it leaves the works is first treated with chemical reagents, the nature of which is not stated, by which the organic matter is separated in the form of a flocculent precipitate. A large quantity separates at once, and the remainder is deposited in tanks, divided into partitions to make the course longer. There are a double set of tanks, one of which may be cleaned while the other is in use. The water when it finally leaves the tanks is perfectly clear, and it was found by the commissioners that when allowed to stand for several weeks it underwent no alteration; the purification is therefore complete.

—S. Y.

Improvements in the Treatment and Utilisation of Sewage. C. T. Kingzett, Stamford Hill. Eng. Pat. 10,879, September 14, 1885. 6d.

THE sewage is either filtered through finely-powdered coke or is defecated by the addition of finely-powdered coke in conjunction with the use of clay, lime, or compounds of iron and alumina. The sludge may be pressed, used as a manure, or else air-dried and used as an ordinary fuel in boilers and furnaces.—C. C. H.

Improvements in the Treatment and Utilisation of Sewage. C. T. Kingzett, Stamford Hill. Eng. Pat. 11,436, September 25, 1885. 6d.

IN this specification it is proposed to defecate sewage by means of soot used in conjunction with clay or lime or with the saline deposit, or the chalybeate water found at Southborn-on-Sea, which contains large quantities of sulphate of iron and alumina. The soot may be substituted by powdered coke with or without clay or lime, used with the chalybeate water or with similar saline substances.—C. C. H.

(C) DISINFECTANTS.

A New or Improved Antiseptic, Deodorant, and Disinfectant Compound. P. Ockenden, London. From H. Roche and H. T. Tomsitt, Melbourne. Eng. Pat. 10,212, August 28, 1885. 6d.

ORDINARY linseed meal of commerce, by weight about 94 parts, is mixed with dried and pulverised leaves of the eucalyptus 3.5 parts, dried and pulverised seed of the eucalyptus 1.25 parts, oil of eucalyptus 1.25 parts. An alternative method of preparation is the addition to the linseed meal of an alcoholic extract of the seeds and leaves of the eucalyptus. The object of the patentee is the preparation of a crushed linseed possessing septic qualities and specially adapted for the well-known use of linseed in surgical treatment.—C. C. H.

Improvement in the Preparation of Hygienic and Disinfecting Substances, and use of the same as Candles, Night-lights, and such like. E. B. Watson and H. B. Fulton, London. Eng. Pat. 10,576, Sept. 14, 1885. 6d.

THIS is an improvement upon a former patent by the same authors, No. 9341, 1885. In that patent the use of iodine in combination with a hydrocarbon wax or oil made into candles, which when burned acted as a disinfectant, was claimed and the patentees have now discovered that if a small quantity of sulphur be mixed with the iodised wax, instead of hydriodic acid being given off, iodine and finely-divided sulphur are dispersed through the atmosphere, which is attended with a considerable increase in the disinfecting qualities.

—C. C. H.

Improvements in the Manufacture of Vitriolised Ash, and Application of same to the Deodorisation and Purification of Polluted Water and Refuse Matters. T. H. Cobley, Dunstable. Eng. Pat. 11,542, Sept. 28, 1885. 6d.

ASHES or clinkers from boiler furnaces, etc., are furnished with a material containing sulphur, such as spent oxide

of iron: they are then ground with about five per cent. of common salt and 16 per cent. of sulphuric acid of 120° T.; the whole is removed from the mill and allowed to dry. The patentee states he aims at the production of "a chloro-sulphate or chloro-sulphite of iron and alumina." The compound so prepared is used for the defecation of sewage. Where much colouring matter proceeding from dyeworks is present in the sewage, the treatment by the vitriolised ash is to be followed by the addition of a milk of carbonate of lime, ground chalk, or waste lime from soap works.—C. C. H.

XVIII.—ELECTRO-CHEMISTRY.

On Mercurous Sulphate. G. Buchner. Chem. Zeit. 10, 759.

AS mercurous sulphate is frequently used for electro-technical purposes, and particularly in telegraphy for filling batteries, it is of interest to know that the salt is not by any means so liable to oxidation as is generally supposed. Several experiments, which in some cases extend over a period of three years, go to prove that in no case was the change which the mercurous salt underwent very great. Thus, when exposed for two years to the most unfavourable conditions, not more than 10 per cent. were found to have been oxidised. This, however, is of no consequence whatsoever in using the salt for the above-mentioned purposes, as the mercury which must necessarily be formed by the decomposition of the mercurous salt unites with the mercuric sulphate in presence of water, reproducing the mercurous derivative.

—A. R.

New Forms of Apparatus for Electro-Chemical Investigations. Nic. v. Klobukow. Chem. Zeit. 10, 792—793.

Universal Stand for Electrolysis.—The platinum basin S, Fig. 1, which forms the negative electrode, is supported by the ring R, to which are soldered three platinum projections. The electrode E fits the bottom of the basin

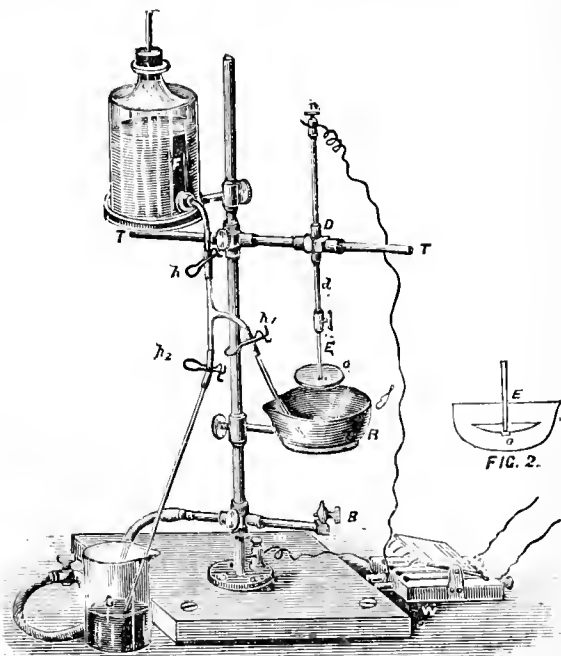


FIG. 1.

exactly (Fig. 2), and is perforated with a hole near the centre to allow of the circulation of the liquid. The cross piece T T is made of non-conducting material. The arrangement of the wires is obvious from the diagram. The basin is warmed if necessary by the small

burner B. The metallic deposit is washed by the liquid in the bottle F; when the clip h_2 is closed and h open, the liquid flows from the bottle into the basin; when h is closed and h_2 open, it is siphoned from the basin into the breaker G. The carrier d is graduated so that the distance between the electrodes may be regulated.

Elbow Apparatus for Electrolysis.—The apparatus Fig. 3 is intended for the estimation of the gaseous products of electrolysis, when evolved in small quantity, or for the investigation of liquids which are acted on by the air. Two wide glass tubes are fused together at an angle of 90° , and are provided with narrow tubes a and a' , through which the evolved gases pass into the eudiometer

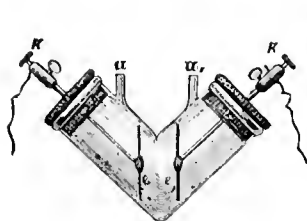


FIG. 3.

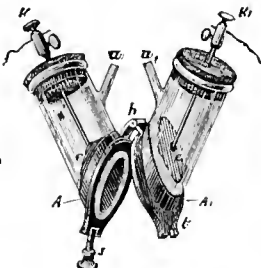


FIG. 4.

tubes. The platinum electrodes c and c' may be of various forms, flat or corrugated discs, spirals of wire, and so on. Their distance is regulated by the stout wires which pass through the corks. The arrangement shown in Fig. 4 is adopted when it is desired to keep the products of decomposition separate. This is accomplished by means of a membrane of parchment or bladder fixed between the armatures A and A' , which are connected by a hinge h , and are firmly closed by the screw s which passes through the slit t .—S. Y.

Improvements in Secondary Voltaic Batteries. Chas. Moseley and Thos. Parker. Eng. Pat. 11,307, September 23, 1885. 6d.

THE positive plates are made of sheet, strip or any convenient form of lead, with the surface perforated, corrugated or roughened. These plates are then subjected to the action of nitric acid, or of a solution of nitric and sulphuric acids, or to the vapours of the solution or solutions, and are then ready for use in the construction of the battery. The negative plates are constructed as above, but instead of the acid treatment the interstices of the plate are packed with oxide of lead or with spongy lead. The positive and negative plates are then immersed in dilute sulphuric acid, and are separated from each other in the usual way. Batteries thus formed are claimed to have a greater storage capacity, and the plates are said to be less liable to disintegration.—B. T.

Improvements in Voltaic Batteries. Thomas John Jones. Eng. Pat. 11,454, September 25, 1885. 8d.

CONSISTS in the use of elastic metal clips and distance-pieces of various forms, drawings of some of which are given, to hold the elements of a cell in position. The clips and distance-pieces are coated with celluloid, and algin or alginate acid.—B. T.

Improvements in the Manufacture of Plates or Elements for Voltaic Batteries. T. J. Jones and W. H. Tasker. London. Eng. Pat. 11,652, September 30, 1885. 6d.

A DRY MIXTURE, composed of definite proportions of an oxide of lead, preferably litharge, an inert porous material as pumice stone, and about 5 per cent. by weight of the lead oxide of one of certain specified salts (ammonium sulphate preferably, but also ammonium chloride, carbonate, chromate or phosphate, or again, sodium or potassium chloride, sulphate or chromate). Such mixture is composed in a mould and steamed. The salt is dissolved, combines with the oxide, and causes the mass

to set, the latter object being ensured by afterwards thoroughly impregnating with a solution of ammonia. A dense coherent, and yet porous plate, is produced. A little glycerine, mixed with the steam, renders the plate harder. It is converted by electrolysis into spongy lead or lead peroxide. Oxidation is helped by a previous immersion in a hot solution of chloride of lime, or by the admixture of a certain proportion of peroxide of lead instead of the inert porous material. The part at which contact is to be made is rendered more conducting by facing with a mixture of the oxide of lead and the salt, without any inert material.—E. T.

Improvements in Galvanic Batteries, and in the Preparation of Liquid to be used in such Batteries. Alexander Schanschliel. Eng. Pat. 12,378, October 16, 1885. 8d.

CONSISTS of elements of zinc and carbon immersed in a liquid prepared as follows:—To basic sulphate of mercury add three times its weight of water, then add strong sulphuric acid, drop by drop. The basic sulphate will be dissolved. Stop the process when the drop falling in produces a precipitate. When filtered and cool, the liquid is ready for use. In the working of the battery the mercury is recovered in a metallic state, and also as a grey powder.—B. T.

Improvements in the Manufacture of Filaments for Incandescent Electrical Lamps. O. R. Swete and W. C. Main, Battersea. Eng. Pat. 6167, May 6, 1886. 4d.

THE authors claim the use of any suitable vegetable fibre, preferably that known as Mexican fibre, thickened to the desired extent by repeated immersions in pyroxiline, such as gun cotton dissolved in ether, the latter being rapidly absorbed, by suitable means, after each immersion. The fibre is then reduced to a uniform cross section, by means of a draw-plate, and carbonised. It is claimed that such filaments are very efficient, free from brittleness, and lasting.—E. T.

Process for the Production of the Ferrieyanides of Potassium, Sodium and Ammonium, by Electrolysis. C. Petri, Alsace, Germany. Eng. Pat. 7426, June 2, 1886. 4d.

THE electrodes are placed in cells separated by porous partitions. The cell of the negative electrode is filled with water, while that of the positive electrode is filled with a solution of potassium ferrocyanide. On passing an electric current of an electro-motive force of 1.4 to 5.4 Volt, the potassium ferrocyanide at the positive electrode is converted into ferrieyanide, while in the cell of the negative electrode potassium hydrate is separated, under formation of hydrogen, and the water of the cell is converted into potash lye. The current is passed through until all ferrocyanide is converted into ferrieyanide. Both solutions are then drawn off and treated separately, for obtaining potassium ferrieyanide and caustic potash. The process can be carried on continuously by causing the ferrocyanide solution and the water to flow continuously into one part of the respective cells, while the ferrieyanide solution and potash lye flow off continuously from another part of the cells. If the negative cell be filled with mercury, the potassium ferrocyanide is converted into ferrieyanide and potassium. The latter is taken up by the mercury, forming potassium amalgam. The above-described process is equally applicable for the production of sodium and ammonium ferrieyanide.—S. H.

Improvements in Clark Standards of Electro-motive Force and other Galvanic Cells having Mercury Electrodes. A. Muirhead, London. Eng. Pat. 8376, June 25, 1886. 6d.

To render portable cells containing mercury as an electrode, the mercury is enclosed in a cage of platinum or platinum-iridium wire, or in a small cell covered with platinum wire gauze, or perforated platinum sheet. The mercury adheres to the platinum, and does not readily separate from it when shaken.—E. T.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Iodoform Powder. G. Vulpins. Chem. Zeit. 10, 791.

IT has been the object of manufacturers to prepare iodoform in the finest possible powder. It is sold in a finely-powdered state, as a still finer precipitate, and in the form of extremely thin scales. The finely-powdered or precipitated product is well suited for mixing with other bodies in the preparation of ointments, but when dusted over wounds with a hair pencil it is apt to cake together in lumps. If not sufficiently fine, or when in the form of scales, it is not thoroughly taken up by the brush. A product is now prepared in the form of a moderately fine powder, which does not cake together and which adheres perfectly to the brush, and this is recommended when iodoform is to be used alone.—S. Y.

On the Njimo Wood. Hugo Schulz. Pharm. Zeit. 31, 350.

THIS wood is obtained from the interior of the Cameroons, and contains a principle which is said to act like pepsin. The drug is found in commerce partly in billets with but little bark, partly as thick circular sections of the root uniformly covered with bark. The wood of both stem and root possesses a beautiful yellow colour, that of the former being dashed with red. It is easily reduced to powder with a rasp, and possesses an odour like musk. It contains numberless circular pores which contain yellow resin. The alcoholic extract of the drug is yellow by transmitted light, but exhibits a green fluorescence resembling manium glass. It appears to contain no alkaloid. The resin contains a bitter substance with a faint aromatic smell. The plant itself is not known, and it is even unknown to what family it belongs.—S. Y.

On Salol. E. Ghillany. Zeit. Oesterr. Apoth. Ver. 24, 229.

PHENOLSALICYLATE, to which the name "Salol" has been given, is now employed as a medicine. It is a white crystalline powder which possesses an aromatic odour, is scarcely soluble in water, but dissolves easily in alcohol and ether, and melts at 45°. The alcoholic solution is coloured red-brown by ferric chloride. According to Dr. Sahli, it acts at least as powerfully as sodium salicylate, and it is also recommended as an antipyretic and antiseptic.—S. Y.

On the various Digitalins of Commerce. Lafon. Journ. Pharm. Chim. 6 Sér. 13, 548.

THE author has examined the digitalins of Nativelle, Homolle and Quevenne, Duquesnel, Mialhe, and Merck, and also Merck's digitoxin. The French brands exhibit the reactions given in the French Pharmacopœia: they dissolve easily in chloroform, and slightly in ether, but are insoluble in benzene, and they are coloured green by concentrated hydrochloric acid. The German digitalin is insoluble in chloroform and gives no reaction with hydrochloric acid. Merck's amorphous and crystallised digitalins do not exhibit the reaction recently described by the author (a blue green colouration on addition of equal parts of sulphuric acid and alcohol and a drop of ferric chloride): but the digitoxin gives all the reactions. The author therefore considers that Merck's digitoxin is identical with the digitalin of Nativelle, notwithstanding that it is yellow and amorphous.—S. Y.

On the Lobelia Alkaloids. Prof. Dragendorff. Pharm. Zeit. Russl. 25, 353.

IN addition to the alkaloid lobelline which is prepared from *Lobelia inflata*, the author has obtained a second alkaloid both from this plant and from *Lobelia nicotianifolia*, which grows in the East Indies. The lobelline is extracted from the ammoniacal aqueous extract by agitation with petroleum spirit, the second alkaloid by agitation with chloroform. Both compounds are poisonous. The composition will be given shortly.—S. Y.

Concissine. K. Polstorff. Ber. 19, 1682—1685.

IN a previous communication (*Ibid.* 19, 78) the author, in conjunction with Schirmer, described the preparation of an alkaloid from the bark of *Holarrhena Africana*, which was considered to be identical with concissine, a base isolated by Haies from the bark of *Wrightia antidysenterica*. The author has extracted the same alkaloid from the seeds of the East-Indian *Holarrhena*. This plant, however, yields less concissine than the African species (5kilos. of seeds gave about 4grms. of pure alkaloid). The base $C_{12}H_{20}N$ forms colourless needles, melting at 121.5°. Its hydrochloride $C_{12}H_{20}N.HCl$ crystallises in groups of needles, and the aurichloride $C_{12}H_{20}N.AuCl_4$ in golden-yellow needles. As a further proof of the identity of the base with concissine, the author prepared and analysed the nitrate and the picrate. The former crystallises in anhydrous small needles, and the latter in lustrous gold-coloured needles.—D. B.

Notes on Quinine Hydrate. Flückiger and O. Hesse. Pharm. J. 16, 3, 897 and 937.

IN reference to Fletscher's statement that quinine hydrate contains only 1 mol. H_2O (*Ibid.* 385), Flückiger communicates experiments from which it is deduced that quinine crystallised from a cold aqueous solution, and dried at 10°, contains 3mols. H_2O . On the other hand, quinine precipitated by ammonia from concentrated solutions, has the composition of a hydrate containing 2 mols. H_2O . Hesse, on the whole, agrees with Flückiger, but is of opinion that precipitated quinine is at first amorphous and free from water, but at the moment of crystallisation, it takes up water to the extent of 3mols. Moreover, the tri-hydrate, even at 20°, loses about 1mol., and at 40—60° the remaining molecules of water. This tendency to effloresce explains why quinine of commerce contains water only equivalent to about 2mols. Hesse has not succeeded in preparing a definite mono-hydrate of quinine.—D. A. L.

Note on Quinine Sulphate. O. Hesse. Pharm. J. 16, 3, 1025—1026.

QUININE SULPHATE of commerce contains as impurity hydroquinine sulphate, from which it cannot be separated by crystallisation, unless it is first converted into acid sulphate. The rotatory power of hydroquinine lies between that of quinine and cinchonidine:—quinine tartrate $[\alpha]_D = -212.5^\circ$; hydroquinine tartrate, $= -176.9^\circ$; cinchonidine tartrate, $= -132.0^\circ$. For this reason the composition of commercial quinine sulphate cannot be determined by the optical method, for the diminished rotation can as well be due to the presence of hydroquinine as to that of cinchonidine. This notice is a reply to De Vrij, who found cinchonidine in all commercial samples of quinine sulphate.—D. A. L.

Improvements in the Manufacture of Salicylic Acid and of the Substitution Compounds and Homologues thereof. J. Y. Johnson, London. From Dr. F. von Heyden, Dresden. Eng. Pat. 7801, June 10, 1886. 4d.

THIS specification relates to improvements in the process described in inventor's patent of July 15, 1884, No. 10,167 (this Journal, 1885, 551). It has been found that the manufacture of salicylic acid can be simplified by causing the carbonic anhydride under pressure, in place of being introduced into the vessel in which the materials are kept at a low or atmospheric temperature, to act on the materials whilst they are maintained at a temperature of from 120 to 145 degrees. Special care must be taken not to allow the heat to exceed these limits, otherwise phenol would be separated and the process would have to be completed as described by Kolbe in Patent 595, February 17, 1874, which the present improvements are intended to obviate. Corresponding results are obtained by the treatment of the homologues and substitution compounds of phenol.—D. B.

XXI.—EXPLOSIVES, MATCHES, Etc.

Improvements in the Manufacture of Explosives. Dingl. Polyt. J. 261, 25–29.

MARKGRAF of Neunkirchen published some experiments on two new explosive substances introduced into commerce by Hellhof of Berlin, and termed Hellhoffite and Carbonite. The Hellhoffite consists of 1 part dinitrobenzene and 1.5 parts nitric acid, or 1 part nitrobenzene and 2.5 parts nitric acid; the latter mixture is preferable. It does not explode by a sudden blow, but it gives off unpleasant vapours on burning, and on being stored eats away the paper-cases of cartridges. Owing to these disadvantages the carbonite was prepared, which is said to consist of nitrobenzene, potassium nitrate, sulphur, and kieselguhr. It has a neutral reaction, is also proof against explosions due to sudden blows, but its explosive force only equals that of dynamite. Tranzl, of Vienna, criticises adversely the use of these explosives. According to him, Hellhoffite is simply an imitation of Sprengel's explosive compounds, the applicability of which the latter inventor himself declared as scarcely probable. The pretended advantage that the explosives may be prepared in the mine shortly before use is really a disadvantage, since it would increase enormously the number of accidents. Furthermore, their preparation is expensive; the paper-cases of the cartridges must be often renewed and the action of the nitric acid on the percussion cap may cause a premature explosion. F. Holzner reports on the use of Hellhoffite for filling shells. The front part of the shell contains a closed glass vessel filled with nitric acid, whereas the back is filled with finely-crystallised metadinitrobenzene. On firing, an intimate mixture of both takes place, which is exploded by the fuse. Experiments in different countries gave contradictory results. General Abbot, of New York, publishes the composition of some new American explosive compounds. Atlas-powder (Repauno Chemical Company, Philadelphia) consists of:—

	A.	B.
NaNO ₃	2	31
Cellulose	21	11
MgCO ₃	2	2
Nitroglycerin	75	50

Judson-powder (Judson-powder Company, Rustie):—64% NaNO₃, 16% S, 15% C, 5% C₂H₅(O.N)₂ (Nitroglycerin). Judson-powder is prepared by grinding nitre, sulphur, and carbon, each separately, mixing them in a drum and heating them with steam to 177° until the sulphur melts and coats the nitre and carbon. After cooling the mass forms grains, which are sieved and coated with nitroglycerin. The fine division of the latter compound is said to produce a more powerful explosion. M. v. Foerster, of Walsrode, issued a pamphlet on experiments with gun-cotton, and the application of compressed gun-cotton for military purposes. From it we learn that wet gun-cotton (25% H₂O) acts more powerfully than dry cotton. A greater specific gravity increases the action of open charges. If there is a space between the charge and the body to be attacked, the effect decreases rapidly. Closed charges show at the percussion cap a power six times as great as at a point which is most distant from the cap. That is to say, that the transmission of the explosive force of gun-cotton is very small. This explains why gun-cotton is not applicable for mining purposes.—S. II.

XXII.—GENERAL ANALYTICAL CHEMISTRY.

The Precipitation of Ammonium Magnesium Phosphate in presence of Ammonium Citrate. C. Mohr. Chem. Zeit. 10, 675.

THE author shows by a series of experiments that the Belgian and French method of determining phosphoric acid in superphosphates, by precipitation of the ammonium magnesium salt in presence of ammonium citrate, gives results which are very much too low. This he estimates at 5.5 per cent. The chief sources of error of this method are due to the fact that the soluble and the dibasic phosphoric acid are determined in one operation. The two operations may be readily separated, as the

soluble phosphoric acid may be much better determined without ammonium citrate. The addition of ammonium citrate is only necessary for dissolving the dibasic salt. The author recommends the following modification: 2grms. superphosphate are rubbed in a mortar with warm water and an excess of sodium acetate added. The precipitated iron and alumina phosphates remain in the residue. The mass is filtered and washed, and made up to 200cc. Of this 50cc. may be used for the determination of the soluble phosphoric acid. The residue is digested with 15cc. of an alkaline solution of ammonium citrate for one hour at 40° to 50°, filtered and precipitated with magnesia mixture. The loss does not exceed 0.3 per cent. The two amounts are then added.—J. B. C.

Determination of Silicon in Iron. L. Blum. Chem. Zeit. 10, 702.

THE author gives data of the method, previously described (*Chem. Zeit.* 9, 1373), for determining the amount of silicon in iron, by employing a solution of bromine in hydrochloric acid. He compares it with the method in general use now—viz., dissolving the substance which has been weighed off, in 200ccm. of water, 100ccm. hydrochloric acid and 20grms. of potassium chlorate, evaporating, filtering, washing with hydrochloric acid and water, igniting and weighing. The author endeavours to account for the fact that this latter method gives somewhat lower figures than his, by assuming that some silicon chloride or silicon hydrochloride is formed and escapes when the reaction is at its height, whereas no loss occurs with his method, as the corresponding bromine compounds are more readily decomposed before they can escape. The latter method also is much preferable, for the solution filters very well, this not being the case when the iron has been treated with potassium chlorate.

It is advisable to dissolve the iron in an evaporating dish. This saves time, and the results are not influenced in the least.

In order to obtain the silica perfectly white after ignition, the precipitate should be very thoroughly washed with the solution of bromine in hydrochloric acid.—A. R.

Determination of Phosphoric Acid in Thomas-Slag. Dr. T. Klein. Chem. Zeit., 10, 721.

IN all the methods at present in use for determining the amount of phosphoric acid in Thomas-slag, oxidising agents are employed. Assuming this slag to contain iron phosphide, it might be supposed that the amount of phosphoric acid found by analysis would somewhat exceed the quantity originally contained in the substance owing to the oxidation of the phosphorus. This, however, does not appear to be the case.

While the use of sulphuric acid gave no good result, it was found possible to decompose the slag by heating it with ordinary hydrochloric acid for more than an hour. The amount of phosphoric acid found in several experiments agreed with the quantity obtained by fusion with soda and nitre, thus proving that the quantity of iron phosphide contained in the slag is either exceedingly small or that it is not decomposed by fusion.—A. R.

A New Method for the Determination of Zinc. G. Löse-kann and Dr. Th. Meyer. Chem. Zeit. 10, 729.

ON adding to a solution of zinc in hydrochloric or sulphuric acid, which has been neutralised with ammonia, a sufficient quantity of disodium phosphate, a voluminous white precipitate, Zn(NH₄)PO₄, is obtained, which becomes crystalline on boiling the solution, and exactly resembles the corresponding magnesium compound. On heating over the blow-pipe, it melts to a transparent fluid, which, however, solidifies again in a Bunsen burner. The weight of the pyrophosphate thus formed very soon becomes constant when heated over the blow-pipe. The analytical data given would show that the method is an excellent one. It is best to precipitate the phosphate by mixing the zinc solution with excess of

ammonia and disodium phosphate, and then adding hydrochloric or sulphuric acid, drop by drop, until the reaction is neutral. Slight excess of alkali or acid is, however, of no consequence if a sufficiently large amount of disodium phosphate has been added. The solution in which the precipitate is suspended is then boiled, filtered after standing a few hours, and washed with hot water until no more phosphoric acid can be detected in the washings by molybdenum solution.

This method is also applicable to the separation of zinc and magnesia, but only when the metals are present as sulphates, unless there is only a small percentage of magnesia, when the chlorides also may be used. Excess of ammonia and disodium phosphate are first added, and the mixture allowed to stand a few hours. All the magnesia is precipitated, whereas the filtrate contains all the zinc, which, in its turn, may be precipitated as phosphate by exactly neutralising the solution.

The results are arrived at very rapidly, though without impairing their exactness, and this method, therefore, promises to render great service to those who have frequently to make determinations of zinc.—A. R.

Determination of Nickel on Nickel-plated Iron Goods.

Dr. A. Köbrich. Chem. Zeit. 10, 747.

THE following method for determining nickel on nickel-plated goods may be speedily carried out, and gives good results:—The articles are put into a mixture of equal parts of nitric acid (sp. gr. 1.18) and water. The nickel plating begins to dissolve at once, and when only iron is visible the goods are removed from the acid solution and washed. The solution is then heated with hydrochloric acid as long as there is any ferrous salt present. On now adding sal-ammoniac and excess of ammonia and gently heating for an hour, the nickelous oxide dissolves readily, and may thus be separated from ferric hydroxide. The latter is again treated with sal-ammoniac and ammonia, and washed on the filter with dilute ammonia until the filtrate is no longer coloured brown on addition of ammonium sulphide. The filtrates are united, treated with ammonium sulphide and acidified with acetic acid. The nickel sulphide thus precipitated, after being dissolved in nitric and hydrochloric acid, is determined in the usual way as metallic nickel.—A. R.

A simple Air-pump for use in the Laboratories of Works, etc.

O. N. Witt. Chem. Zeit. 10, 760.

THE author reviews the different kinds of air-pumps at present in use. The one here described does not, as the two kinds generally employed in laboratories, require either a strong pressure of water or a long column of discharged water. Now, as one or the other of these requisites is not often to be found in works, the author has constructed a pump, the principle of which depends on the hydraulic ram. It can be looked upon as a modification of Jagno's pump, the theory of which has been explained by Mendeleeff, Kupitschoff and Schmidt (*Annalen*, 165, 63). Jagno's pump works with a column of water and fall $1\frac{1}{2}$ meters high. If the pressure is stronger, the fall may be successively shortened to 40cm.; if smaller, it must be correspondingly lengthened. These are very modest requisites, and the only reason why this pump has found so little favour in laboratories is due to its liability to get out of order, and Linnemann's (*Annalen*, 177, 295) improvement on that pump is somewhat expensive. The adjoining figure will readily explain the construction of the pump as recommended and used by the author for several years. A is a T-shaped glass tube, 10mm. wide, the lower end of which, as also the end of the side-piece, is widened out. The upper end is carefully ground. B is also a T-tube, consisting of a piece 25mm. in width and a piece of the same tubing as used for A. All three extremities of B are widened out. A is connected with B by means of a very good cork stopper (not caoutchouc), which should be as long as possible, and very compact. A should fit into B in such a way that both tubes are perfectly concentric, and that while A can slide perpendicularly but with strong friction in B, the possibility of an oscillation in a

lateral direction is altogether excluded. The upper opening is closed by means of a perfect membrane of sheet caoutchouc, 5mm. thick. As it is not easy to obtain perfect caoutchouc, and the least fault may cause it to split, it is best to tie two or three thinner sheets, one over the other, on to the tube. The thickness of the sheets employed should depend on the water-pressure at disposal, and must be tried in each special case. A must be pushed into B so far that the water which enters at b, while slightly lifting the caoutchouc-sheet, is jerked out at a. Under ordinary circumstances, this occurs

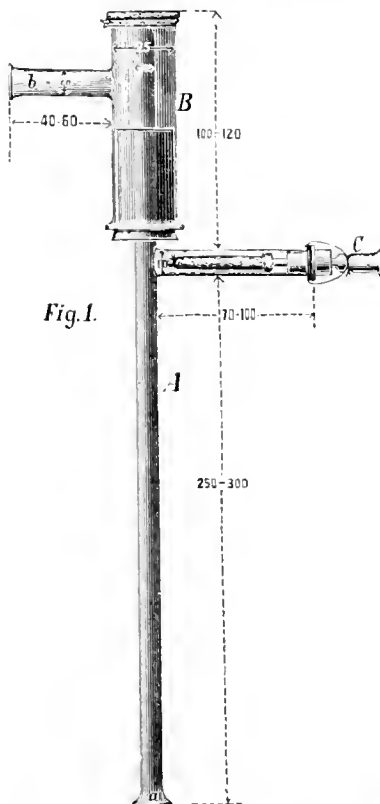


Fig. 1.

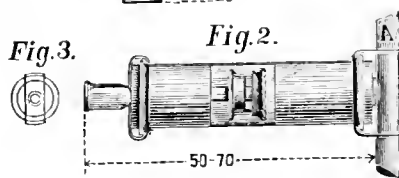


Fig. 3.

Fig. 2.

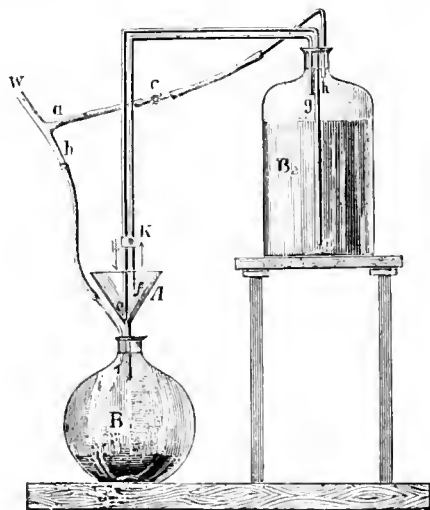
when, on blowing into b, a loud sound, resembling a blast from a trumpet, is heard. C is a Bunsen valve, which must have been made with great care, and should fit perfectly. It should, moreover, be so small that it works easily in the tube, and offers a sufficient passage for the expelled air. As the whole pump oscillates very considerably when in action, the junctions must be tied with silk and thin wire, and fastened so thoroughly that the various parts cannot be displaced. Much depends on the good quality of the small valve: it is not easily made, and the black tubing which is used for it gradually loses its elasticity. It is therefore advisable to replace it by an arrangement such as the one shown in Fig. 2. This consists of a wide piece of tubing, which is drawn over and attached to the shortened adjoint piece of A by means of a cork. A thin piece of tubing, ground in front, is passed through the other end of the wide tube, and on the former glides a somewhat broader but short tube, widened at each end, over the front opening of which a strip of caoutchouc cloth is stretched (Fig. 3), just broad enough to cover the opening of the small tube.

By sliding this small valve along the tube, the best position for it must be ascertained. All junctions, again, should be carefully fastened with wire or silk thread. Before using the pump, it is fastened below *b* to a heavy stand. While working, it emits a deep humming sound. As the exhaustion of the vessel attached to the pump proceeds, the beats of the pump become heavier and slower, until finally each can be counted separately. If, now, the water be turned off, the pump of itself closes the receiver, an advantage not possessed by any other pump.

This pump cannot, of course, evacuate so thoroughly as other water-air pumps, considering each to be working under the most favourable conditions. Even if the valve is very carefully constructed, it is impossible to obtain a vacuum under 50–60mm.; but this pressure suffices for all filtrations, even for all distillations under diminished pressure.—A. R.

A New Self-regulating Arrangement for Filtering. F. W. Dafert. Chem. Zeit. 10, 762.

WHEN large quantities of a liquid are to be filtered as quickly as possible through a small filter, the following apparatus will be found useful: The liquid to be filtered, contained in *B*, is led by means of a syphon into the filter in funnel *A*, and thence passes into *B* under pressure. As the supply at *A* must be greater than a discharge at *f*, an excess of the fluid must be provided, and then again returned to *B*. This is effected through the tube *f g* by means of a weak counter pressure exerted at *h*, which can be regulated by the stop-cock *c*. When



the filter is filled to *f*, this second syphon commences to act, but in the reverse direction. The syphon *d c* is best filled by closing *f* and blowing air through *h*. Through the cork of *B*, a separating funnel may be passed, for introducing any desired quantity of the liquid to be filtered. The air admitted through *a* should just be sufficient to cause hardly any alteration in the minus pressure in *B*. The lower end of the lever *d c* should be bent upwards to guard against damaging the filter.

—A. R.

A Thermo-regulator for Low Temperatures. F. W. Dafert. Chem. Zeit. 10, 789–790.

By means of the apparatus designed by the author, constant temperatures, slightly above that of the water supply, may be obtained. The bath itself is not heated by the flame, but only a portion of the current of water with which it is constantly supplied. In the apparatus (Fig. 1) the bath *W* contains an ordinary thermo-regulator *T*, by which the flame *F* is made larger or smaller as the temperature of the water in *W* falls or

rises. The current of cold water enters the bath through the tubes *A* and *B*; the spiral is made of lead tubing. The water which enters the bath through *A* is cold; that which passes through *B* is heated by the flame; thorough admixture of the water as it enters is insured by the introduction of a slow current of air through the tube *E*. The water escapes from the bath through the tubes *C* and *D*. As this arrangement is not convenient for all purposes, the author makes use of the waste water from the first apparatus, connecting the discharge tubes *C* and *D* with *I* and *G* respectively in Fig. 2. By

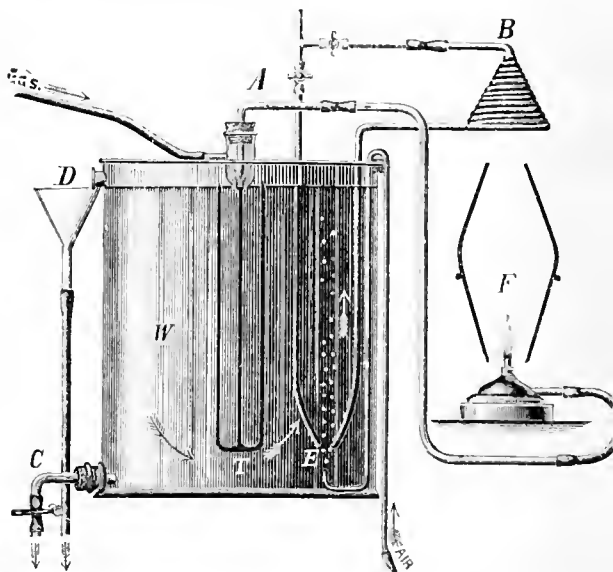


FIG. 1.

passing a sufficiently rapid current through the first apparatus, the temperature of the water is not sensibly altered before it leaves the second. The author describes experiments made to test both forms of apparatus, in which, while the temperature of both the atmosphere and of the

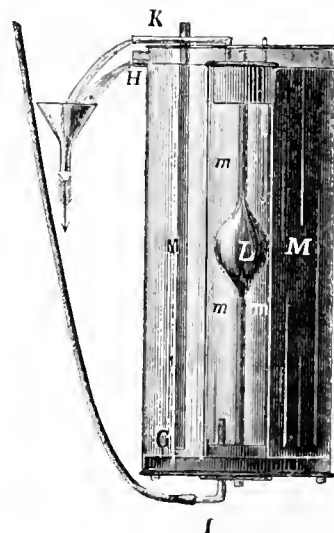
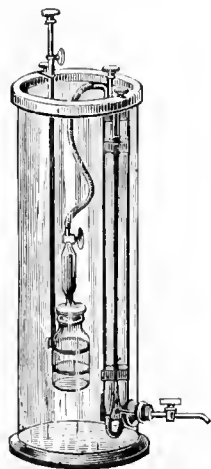


FIG. 2.

water supply varied considerably, that of the water in the bath *W* did not alter more than $\pm 0.045^\circ$, and in the bath *L* more than $\pm 0.105^\circ$. Again, if the temperature of the water in *W* was raised or lowered by the introduction of boiling water or ice, the normal temperature was again attained after a few minutes.—S. Y.

Azotometry and Azotometer. W. Knop. *Zeits. Anal. Chem.* 25, 301–308.

THE author calls attention to the fact that in 1859 he drew attention to the possibility of using sodium hypochlorite and hypobromite for the determination of nitrogen in ammonium salts and certain organic substances. He then described the apparatus which he used, and which he called an "azotometer," in order to distinguish it from other arrangements for the determination of nitrogen. Since then Hüfner (*Zeits. f. Physiol. Chem.* 1, 335), Hofmann, and Jacoby (*Zeits. Anal. Chem.* 24, 307) have published papers on the method. The author now describes a modified apparatus, of which the following is a description. The decomposing vessel is of glass, and closed by a glass stopper, which is expanded in the centre to a cylinder, and closed at the top by a tap: the cylinder is filled with beads, with a ball of platinum wire at the bottom to prevent them from falling into the vessel. Before placing the required amount of brominated soda solution in the decomposing vessel, this stopper is removed and inverted, in order to pour some of the solution over the beads and completely wet them; the necessary amount of solution is then added to the vessel, and the stopper replaced, and allowed to remain until no more solution drops back. The glass tube containing the urine or ammonium salt is then gently placed in the vessel with



the aid of forceps, in such a way that the two liquids can be later mixed by shaking. The decomposing vessel is then connected with the one end of a U-tube, filled with water, and the ammoniacal solution slowly mixed with the hypobromite solution by gently tilting the vessel. The evolved gas is freed from any ammonia mechanically carried over by its passage through the solution on the beads. Finally the tap is closed, and the solutions well mixed by shaking, in order to complete the evolution of the nitrogen; the tap is then opened, and the whole apparatus immersed in a cylinder containing water. The illustration shows the arrangement of the apparatus, together with the cooling cylinder; the mouth of the latter is surrounded by a brass rim, to which are fixed connections for holding the vessel and the U-tube in the required positions. One limb of the U-tube is graduated, and the level of the water in the two limbs can be adjusted by means of a tube with a stop-cock, which passes through the side of the cooling cylinder. The errors in estimations made with this apparatus, due to the absorption of nitrogen by the brominated solution, and errors in measuring the quantity taken with a pipette, can be determined by making a series of determinations with a standard solution of ammonium chloride, and adding the difference in cc. between the amounts found and calculated to the number of cc. of nitrogen obtained in an actual estimation.—G. H. M.

Analysis of the Hot Spring of Leuk (Canton Wallis, Switzerland). G. Lange and R. E. Schmidt. *Zeit. Anal. Chem.* 25, 309–318.

AN analysis of the spring of St. Lorenz, carried out to test the correctness of previous analyses. The temperature of the water was 51.35° C., and the sp. gr. at 15° 1.00194, compared with water at 15° and 1.00109, compared with water at 4°. The water flows in very large quantity (about 500,000 litres in 24 hours) from a rough basin made of slabs of stone. Large quantities of gas

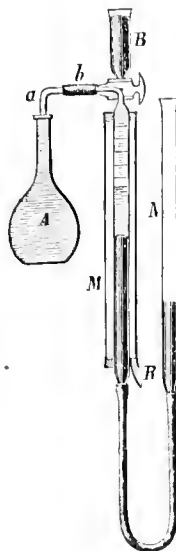


FIG. 1.

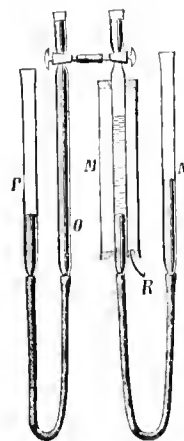


FIG. 2.

are given off at regular intervals. The water is quite clear and odourless, with an insipid taste. In the air small quantities of flocculent iron hydroxide separate out.

The determination of the dissolved gases was made in the nitrometer, arranged as follows:—The flask A (Fig. 1) is completely filled with the water; an indiarubber plug with a capillary tube (a) passing through it, is then inserted in the flask, and the tube is thereby completely filled with water. The whole is then weighed, and the difference between this and the weight of the empty flask and tube gives the amount of water taken. The end of the capillary tube is then connected to the side tube of the nitrometer by the tube b. The nitrometer is then completely filled with mercury, and when the tubes are quiet the flask and measuring tube of the nitrometer



FIG. 3.

are quickly placed in connection, without the introduction of the slightest trace of air. The water in the flask is then slowly heated to boiling. Some water as well as the dissolved gases collect in the measuring tube of the nitrometer. The tube N of the nitrometer should be lowered in order that the boiling may take place under reduced pressure. After boiling for 5 to 10 minutes, the stop-cock is quickly turned through 180°, so that the

flask is placed in combination with the cup B, containing mercury, and the flame removed. Since the mercury stands lower in N than in M, it is not possible for any loss of gas to take place at the moment of turning the tap. It is also impossible for any gas or steam to escape through the mercury cup, since the pressure is inward. A small bubble of gas always remains under the stopper; this is brought into M by lowering the tube N as much as possible, and then turning the stop-cock so that the flask and measuring tube are again placed in connection, and when the bubble has passed over, quickly reversing the tap again.

When the whole of the gas is collected in the nitrometer, it is connected with a second instrument O P (Fig. 2), quite full of mercury. The gas is then transferred by placing the tap I in such a position that it is closed in all directions (a section of the tap is shown in Fig. 3), and the tube M is heated by passing steam through the tube R. When it is quite hot the tube N is lowered, causing the water in M to boil, in order to expel every trace of dissolved gas. The taps are then placed in connection and the gas passes over. It can then be cooled, measured, and submitted to analysis. Two experiments gave 505 grms. water taken, gas evolved 5.06 cc., per 1000 grms. = 10.02; 502 grms. water taken, gas evolved 4.94 cc., per 1000 grms. = 9.84.

The gases evolved from the spring were also collected and analysed.

The determination of the sulphuric acid was made by adding sodium carbonate, in excess, to the hot water, in order to decompose the sulphates of calcium and strontium, the precipitated carbonates filtered off, and the analysis finished in the usual way. It is found that by the precipitation of calcium sulphate solutions with barium chloride, small quantities of calcium sulphate were precipitated as such, thus throwing the results too low.

The strontium was determined by adding sulphuric acid to a solution of the chloride, in sufficient quantity to convert all the strontium and a small portion of the calcium into sulphate. After standing, alcohol was added, and the sulphates filtered off. The precipitate was converted into carbonates, then into nitrates, and the latter separated with a mixture of alcohol and ether.

The manganese was precipitated by ammonium sulphide in the filtrate, after removal of the strontium. This prevents the possible precipitation of traces of strontium with the manganese.

No trace of arsenic was found. The results of two concordant analyses gave the following results:—

	Grms. per kilo.
Strontium Sulphate.....	0.00194
Calcium	1.4286
Magnesium	0.26912
Sodium	0.08715
Calcium Carbonate	0.09650
Magnesium	0.02066
Ferrous	0.00011
Manganous	0.00021
Sodium Chloride	0.00121
Potassium	0.01127
Lithium	0.00037
Ammonium	0.00017
Alumina	0.00051
Silicic Acid	0.03020
Copper Carbonate	slight trace.
Barium Sulphate	trace.
Calcium Phosphate .. .. .	.. .. .
.. .. . Fluoride .. .. .	.. .. .
Arsenic	none.
Nitric Acid .. .. .	.. .. .
Carbonic Acid	0.00390 grm. = 1.97 cc.
Oxygen	0.00091 .. = 0.66 ..
Nitrogen	0.00905 .. = 7.21 ..

Composition of the gas evolved from the spring.

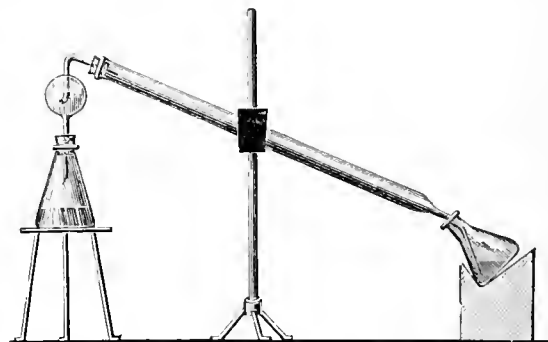
Carbonic Acid.....	2.12 .. by volume.
Oxygen	Trace.
Nitrogen	97.88 .. by volume.

—G. H. M.

Determination of Nitrogen in Coal and Coke. S. Schmitz. Zeit. Anal. Chem. 25, 314—318.

THE author has been in the habit of using the methods of Dumas and Varrentrapp-Will. Dumas' method has

the following disadvantages: Coal and coke burn in an atmosphere of carbonic acid, only very slowly, and the pressure in the tube is often so great that great care must be exercised in order to prevent the tube being blown out. There is always a residue of unburnt substance after 4 to 5 hours' combustion. Varrentrapp-Will's method is the one most generally used. The author found, however, that the results were always too low with coal, whilst with coke they are quite unreliable. A sample of coal which gave 1.77 per cent. nitrogen by the method described below, gave only 1.61 per cent. nitrogen (on dissolving the soda-lime no trace of coal remained unburnt). A coke which gave 1.22 per cent. N, by the new method, gave only 0.71 per cent. by the Varrentrapp-Will's method. Similar results were obtained with other samples of coal and coke.



The author has applied Kjeldahl's method to the analysis of these substances. He proceeds as follows: 0.8—1 grm. of very finely-powdered coal (0.5—0.7 grm. of coke is sufficient) is placed in a ½-litre flask made of good potash glass, together with 1 grm. of finely-powdered mercury oxide, and 20 cc. concentrated sulphuric acid, and heated to boiling for three hours. All varieties of coal, including anthracite, are dissolved in this time. The cooled contents of the flask is then added to a ¾-litre Erlenmeyer's flask containing a little water; 120—140 cc. pure sodium hydrate of 30—32 B. and 35 cc. of a solution of yellow sodium sulphide are then added, a small piece of zinc introduced, and the flask fitted to the apparatus shown in the figure, and the distillation carried on for 20 to 30 minutes. The introduction of the bulb arrangement between the flask and condenser is to prevent the alkaline liquid being spirted over. The ammonia is distilled into $\frac{1}{10}$ normal sulphuric acid, of which 30 cc. are used for coal and 20 cc. for coke, and the excess titrated with $\frac{1}{10}$ normal barium hydrate and rosolic acid. A few of the results obtained were—

	Amount used.	H ₂ SO ₄ used.	Nitrogen found.
Cannel-coal	0.9667 grm.	24.1 cc.	1.78%
from Zeche	0.9176 ..	23.04 ..	1.76
Anthracite	0.6172 ..	1.00 ..	0.52
from Piesberg	0.6393 ..	5.69 ..	0.51

With coke the process is carried out as above, with the addition that, after the mixture has been boiled for one hour 1 grm. of mercury oxide is added, and then 2 grms. of finely-powdered potassium permanganate. The additional amount of mercury makes it necessary to add double the quantity of sodium sulphide solution. The results obtained were—

	Amount used.	H ₂ SO ₄ used.	Nitrogen found.
Coke from	0.7749 grm.	11.35 cc.	1.03%
Zeche	0.6641 ..	11.21 ..	1.18
.. .. .	0.6892 ..	15.31 ..	1.21

In carrying out the nitrogen determination in coke the following varieties must be distinguished: (1.) Coke which has been prepared in a platinum crucible. (2.) Coke from the coking oven after 24 hours. (3.) Coke after 48 hours or more in the oven (patent coke). No. 1 may be determined by the method given for coal; No. 2 gives results with the coke method, which are very

nearly correct—they do not differ more than 0.10–0.15 per cent.; No. 3 only very seldom gives results which are close to correct numbers. The author intends to carry out further experiments on this last point.

—G. H. M.

Modification of Sonnenschein's Method for the Determination of Phosphorus in Iron and Steel. N. Huss. Zeit. Anal. Chem. **25**, 319–326.

THE author has made a series of experiments with three samples of steel, and finds that it is necessary, for the accurate estimation of phosphorus, that the organic matter should be completely destroyed. If this is not done, a portion of the molybdic acid used for precipitation of the phosphoric acid after solution of the iron or steel in acid, is reduced, and comes down with the precipitate of ammonium molybdo-phosphate, and makes the results too high. On the other hand, if the excess of ammonium chloride is not completely driven off, a double decomposition between this salt and the nitric acid takes place, resulting in the formation of aqua-regia, which keeps a portion of the phosphate precipitate in solution, and gives too low results. The author has made direct experiments on the solubility of ammonium molybdo-phosphate, both in aqua-regia and in a mixture of hydrochloric acid and ammonium chloride, and finds that both acid mixtures possess solvent action upon it. In order to avoid the prolonged treatment with potassium chlorate and hydrochloric acid, and subsequent roasting necessary to effect complete destruction of the organic matter and ammonium chloride, Huss recommends the following procedure: 10grms. of steel are dissolved in 200cc. nitric acid of 1.20 sp. gr., and when dissolved, boiled for fifteen minutes to dissolve the carbon, then cooled, and the exact quantity of ammonium chloride solution necessary to convert the whole of the iron into chloride added. This must be accurately calculated, and the amount added from a burette (10cc. of a 28.65 per cent. solution are required for 10grms. steel). 50cc. of an aqueous solution of ammonium molybdate, containing 20 per cent. crystallised salt, is then added. The precipitate begins to separate out at once in the cold, and by heating to 50° the precipitation is complete. At the end of 15 minutes the precipitate is filtered, thoroughly washed with a solution of ammonium molybdate in dilute nitric acid, and then with 1 per cent. solution of nitric acid. The precipitate is spread on a watch-glass and dried not above 80°. The precipitate is then removed from the paper as completely as possible, the latter burnt in a weighed crucible, the precipitate added, and the whole again heated, cooled and weighed. The weight multiplied by the fraction $\frac{1.63}{10}$ gives the percentage of phosphorus. This gives results which closely agree with those obtained by the more elaborate process. The small quantity of reduced molybdenum compound does not affect the results in this determination, since a difference of 0.01grm. on the 10grms. of steel taken only makes a difference of 0.00163 per cent. phosphorus. If, however, the precipitate is dissolved in ammonia, and the determination made with magnesia mixture, the error affects the results, and it is necessary to oxidise with bromine before precipitation with magnesium mixture.—G. H. M.

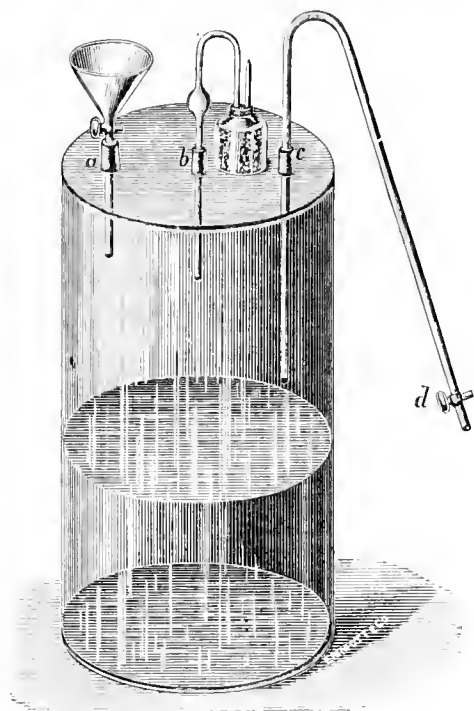
The Determination of Iron Oxide in the presence of Alumina. E. Donath and R. Jeller. Zeit. Anal. Chem. **25**, 361–363.

ADVANTAGE is taken of the fact that when oxide of iron is heated with zinc-dust or finely-ground zinc, a very energetic reaction takes place, and the oxide is reduced to metallic iron. In order to determine iron in presence of aluminium, the precipitated mixed oxides are finely-powdered, mixed with an equal quantity of zinc-dust in a porcelain crucible, the mixture covered with a small layer of zinc-dust, and the crucible then heated for 5 to 8 minutes. The mass is then transferred to a flask and boiled with dilute sulphuric acid, taking care that the iron does not become oxidised. The solution is then made up to a determined volume, and the ferrous salt

estimated with standard potassium permanganate. If commercial zinc-dust is used for the reduction, it is necessary to determine the amount of reducing action which the quantity taken has upon the permanganate solution, and apply this correction to the result. The iron in all iron ores which contain the iron in the ferric state, may be estimated in this way. Iron ores and slags which contain the iron as ferrous oxide, give the results too low; if, however, they are previously oxidised by moistening with ammonium nitrate and subsequent ignition, good results are obtained.—G. H. M.

Apparatus for Washing and Drying Precipitates in the absence of the Carbonic Acid of the Air. A. Dolles. Zeit. Anal. Chem. **25**, 369–371.

THE apparatus is shown in the annexed figure. It consists of a glass cylinder to which a glass plate is fitted perfectly air-tight. The plate has three orifices, *a*, *b*, *c*, to which are fitted india-rubber bungs. Through *a*, a stoppered funnel is passed, through *b* a bent bulb tube connected with a small bottle filled with solid caustic potash; through *c* a syphon with a tap *d* is passed in such a way that it can be slipped up and down without removal. The precipitation is effected in the cylinder and the precipitate washed by decantation, distilled water being added through the funnel and

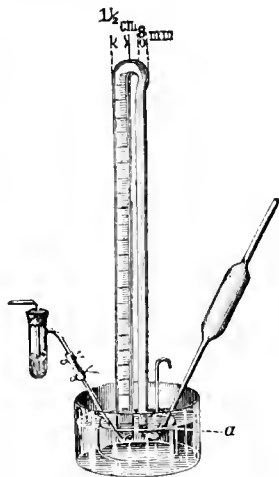


drawn off by lowering the syphon and turning on the tap. If it is wished to wash the precipitate with hot water, the bulb in the tube prevents any condensed steam from getting to the caustic potash. When the precipitate is thoroughly washed it can be freed almost entirely from water by attaching a porous cylinder to the inner end of the syphon and bringing it down to the level of the precipitate; the other end of the syphon is connected with one neck of a Woulfe's bottle, which is connected to a filter pump by the second neck. After an hour or two's suction the precipitate can be transferred to a desiccator.—G. H. M.

Apparatus for the Volumetric Determination of Nitrogen. A. Sonnenschein. Zeit. Anal. Chem. **25**, 371–372.

THE accompanying figure shows an apparatus for measuring the nitrogen evolved in Dumas's method for determining this in nitrogenous substances. The

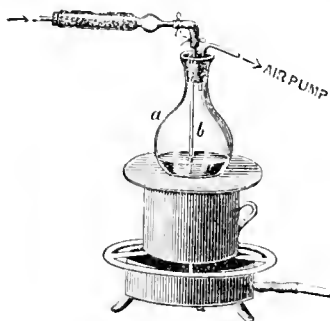
arrangement consists of a measuring tube with a suction tube attached to the side. This is placed in a dish with a handle and the whole is then placed in a larger dish filled with caustic potash. A pipette is then fitted to the end of the suction tube by means of a bung, and the



apparatus is filled with the solution by suction; this is repeated until the tube is quite free from bubbles. When the whole of the nitrogen is collected the small dish and tube are transferred to a vessel of water, and the volume of nitrogen read off.—G. H. M.

The Drying of Fats. A. Sonnenschein. Zeit. Anal. Chem. 25, 372–373.

FATS and fatty acids are usually dried by being heated to 100–110 °C. for some time, and finally placed over sulphuric acid. The method is very imperfect, since the water collects below the fat and only slowly evaporates



through it. The author tares the flask *a*, as shown in the annexed figure, together with the straight tube *b*, weighs in the fat, attaches the flask to a filter pump, and draws dry air through the melted fat until the weight is constant.—G. H. M.

A New Method of Distinguishing Vegetable from Animal Fibre. Hans Molisch. Dingl. Polyt. J. 261, 135–138.

This method is founded on the discovery, made by the author, that by adding to a solution of any kind of sugar first an alcoholic solution of α -naphthol and then concentrated sulphuric acid in excess, a beautiful deep violet colour is produced. On diluting the solution with water a bluish-violet precipitate is formed. When thymol is used in place of naphthol the colour of the solution and precipitate is carmine-red. Both reactions are extremely sensitive, and in this respect surpass both Fehling's and Trommer's tests. As by the action of sulphuric acid upon the carbohydrates and glycosides

sugar is formed, the reaction is also applicable for ascertaining the presence of these substances. The following method is recommended for textile fabrics: To about 0.01 g. of the sample, previously well boiled and washed with water, first 1 cc. of water, then two drops of an alcoholic solution of α -naphthol (15 to 50 per cent.), and at last 1 cc. of sulphuric acid are added. In case of vegetable fibres the liquid at once assumes the characteristic deep violet colour, whereas animal fibres produce a more or less intense colouration, varying from yellowish to reddish-brown. The reliability of this test was proved by applying it to all fibrous materials used in the textile and paper manufactures, as also to cork and the cellular tissue of fungi. Some kinds of silk seem to form an exception to the other fibrous materials of animal origin, as in their behaviour they resemble cellulose. The colouration is, however, quite faint and transient, and therefore cannot mislead. In the case of dyed fabrics the nature of the material composing them can be ascertained by the same process, for the colour does not interfere with the reaction.—F. M.

On the Detection of Liquorice in Beer. H. Hager. Industrieblätter, 1886, 202.

THE constituents of liquorice extract are partly precipitated from their solution by organic acids, such as acetic, succinic, benzoic, salicylic, etc., acids. A small quantity of liquorice added to beer during the process of brewing therefore escapes detection after fermentation, as by the acids invariably formed during the latter process it is converted into an insoluble form, and collects at the bottom of the fermenting vat. Beer to which salicylic acid has been added, or which has turned sour, would likewise appear free from liquorice. The presence of this substance might, however, be proved in the sediment formed in the cask. In order to detect glycyrrhizin, the chief constituent of liquorice juice, in beer, the latter is evaporated to one-fourth its original volume, and the sediment formed mixed with plaster of Paris, and after drying extracted with 90 per cent. alcohol. The hop constituents may be separated by mixing this extract with calcium hydroxide, evaporating to dryness, and again extracting with alcohol. Calcium glycyrrhizinate is left undissolved, from which, by means of acetic acid, the glycyrrhizin is separated.—F. M.

A Method for Rapidly Determining Manganese in different kinds of Iron by means of Permanganate. Meineke. Rep. Anal. Chem. 6, 252.

THE following method has several advantages over those at present in use—viz., more efficient oxidation and solution, reduced filtration and a wide range of application, it being independent of the percentage of manganese present. 0.5–1.0 gm. of ferro-manganese or specular iron, or 1–2 grms. of pig or ingot iron, are dissolved in 15 cc. of a mixture of 3 vol. dilute sulphuric acid (sp. gr. 1.13), and 1 vol. of nitric acid (sp. gr. 1.4); 0.5 cc. of a strong chromic acid solution is then added (100 grms. CrO_3 in 100 cc.), and the mixture, after boiling for a short time, transferred to a 500 cc. flask. Here 20–25 cc. of a saturated barium chloride solution, and very finely powdered zinc oxide, suspended in water, are added, until flocculent ferric oxide has separated. Should the solution not yet be colourless, a further quantity of barium chloride and zinc oxide, but only traces, should be introduced. Having filled up to the standard point, the solution is mixed, filtered through a dry folded filter, and 250 cc. of the filtrate gradually poured into another 500 cc. flask containing an excess of permanganate solution of known strength, and also 20 cc. of a zinc chloride solution (about 25 grms. zinc to 100 cc.). Water is added to the mark, the solution again passed through a dry folded filter, and in 250 cc. of the clear filtrate excess of permanganate is titrated back with antimony chloride.

Having regard to the volume of the precipitate, it must be assumed that, with a dilution of 500 cc., 100–52 Mn

are found instead of 100 Mn, supposing 1grm. to have been weighed off. It is, therefore, necessary either to take 0.9947grm. of iron instead of 1grm., or to multiply the result obtained by 0.9947. Presence of nitric acid is of no consequence if the titration with antimonious chloride is carried out at ordinary temperatures. The more dilute the permanganate solution, and the faster the solution is filtered, the less is the filter attacked. Consequently as little substance should be used as possible, or after precipitating with zinc oxide, the solution should be diluted to a larger volume than 500cc. The strength of the permanganate solution is best chosen such that 1cc. = 1.0–1.5grms. manganese, whatever the amount of the latter in the solution to be titrated.—A. R.

Quantitative Separation and Estimation of Zinc. S. Bein. Rep. Anal. Chem. 275–283.

THE author has investigated the various methods of determining zinc, with special reference to their applicability. To separate zinc from ferrous salts, he recommends the precipitation of the latter by means of sodium succinate. The zinc is then precipitated from the boiling-hot concentrated solution by the addition of sodium carbonate. The precipitate is dissolved in nitric acid, ignited, and weighed as zinc oxide.—D. A. L.

On the Determination of Phosphorus in Steel and Iron. C. Meineke. Rep. Anal. Chem. 6, 303 and 325.

THE author recommends the following modification of the molybdate method, in which the precipitate is ignited and weighed as $P_2O_5 \cdot 4MoO_3$.

The iron solution should consist almost entirely of nitrate. The solution, after filtration, should contain 25 to 30grms. of ammonium nitrate and about 12.5grms. free N_2O_5 or 25cc. of nitric acid of 1.4 sp. gr. The molybdate solution is formed by dissolving 150grms. ammonium molybdate in 1000cc. five per cent. ammonia, and adding this to 1000cc. of nitric acid of sp. gr. 1.4. The iron is dissolved in 50cc. of nitric acid of 1.2 sp. gr.; to this solution 60cc. of nitric acid of sp. gr. 1.4, and 2cc. of chromic acid solution containing 2grms. CrO_3 , are added, and the mixture is boiled for ten minutes. 100cc. of water, and 50cc. of ammonia—sp. gr. 0.91—are now introduced. Now 75cc. of molybdate solution are added to the carefully-stirred iron solution at a temperature of 90° to 95°, and the mixture is allowed to stand for an hour at the ordinary temperature. The precipitate is washed with a fifteen per cent. ammonium nitrate solution containing five per cent. of free nitric acid until free from iron, then placed with the filter without drying in a porcelain basin, and ignited at a moderate temperature. It is advisable to cover the basin and to avoid too high a temperature in order to prevent the further oxidation of the molybdenum oxide. If the precipitate has a bluish colour after ignition, it should be moistened with ammonia and again ignited.

When organic compounds are present, chromic acid should be added or the solution of iron evaporated and ignited. The presence of silicon in iron does not interfere with the process.—S. Y.

The Estimation of Extract and Glycerol in Wine. R. Bensemann. Rep. Anal. Chem. 6, 313.

THE author finds that the method III. 2 b (*Chem Zeit.* 10, 335) gives good results. The extract dried at 110° is completely free from glycerol. The method referred to is as follows (*loc. cit.*):—The alcoholic extract is evaporated in the flask in which it was obtained, on the water-bath, to a stiff syrupy condition. The residue is dissolved in 90 per cent. alcohol; the solution is brought into a 50cc. cylinder graduated in cc., and furnished with a glass stopper, and there treated with 20cc. of alcohol of 90 per cent. 50cc. of ether are then added. After clearing, 25cc. of the ether-alcohol solution are taken (corresponding to 50cc. of wine), and

brought into a flask of 5 to 6cm. diameter, and with a neck 1.5 to 2cm. in width, and the same height. The solution is evaporated to dryness, perfectly dried, and weighed from the desiccator until a constant result is obtained. The weight of the dry residue is the weight of the glycerol, from which the weight of the ash is to be deducted, a weight which is obtained by igniting the residue obtained on drying as aforesaid.—S. Y.

Detection of Free Sulphuric Acid or Hydrochloric Acid in Vinegar. H. Hager. Pharm. Centralt. N.F. 7, 292.

THE author's method, which takes only two or three minutes, is based on Jorissen's reaction. Two drops of East Indian copaiba balsam, and 30 or 40 drops of pure acetic acid, are placed in a test glass and warmed. Two, or at most three, drops of the vinegar are added to the warm liquid, when, if either of the mineral acids are present, a blue-violet colour is produced. The colour is produced more rapidly with hydrochloric than with sulphuric acid. Its appearance is hastened by warming the mixture above 60°.—S. Y.

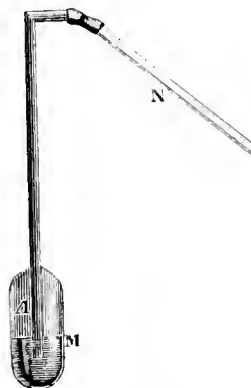
Two Reactions for Morphine. J. Donath. Journ. Prakt. Chem. 33, 563.

1. About 1mgm. of finely-divided morphine is mixed with 8 drops of concentrated sulphuric acid, and to this a small crystal of potassium arsenate is added and thoroughly broken up. When the mixture, which should be kept in motion, is heated until acid vapours begin to be evolved, a blue-violet colour is produced, which, by further heating, changes to brown-red. When diluted with water, the colour is at first red, but with more water becomes green. When shaken with this liquid, chloroform is coloured violet and ether violet-red, the aqueous solution being brown.

2. A drop of a solution of one part of potassium chlorate in 50 parts of concentrated sulphuric acid is added to the mixture of morphine and sulphuric acid, when a very permanent grass-green colour is produced. A faint rose-red colouration is observed at the edge of the liquid.—S. Y.

A New Air Thermometer for the Measurement of Small Variations of Temperature. G. Grassi. Rep. d. Phys. 22, 155.

A VERTICAL TUBE is sealed to, and passes to within a few millimetres of, the bottom of the small glass reservoir A. The vertical tube is bent at right angles, and connected by means of india-rubber tubing with the straight tube of small bore N, which is graduated in



millimetres, and is inclined at an angle given by the equation $\cos a = - \frac{N_0}{V_0} (p + p_1)$, where s is the area of a cross section of the tube N, V_0 is the volume of gas contained in A, and $p + p_1$ the original pressure. The change of volume of the gas in A is registered by the liquid M, which fills the vertical tube and part of

the inclined tube, and occupies a portion of the reservoir A. The original paper contains a discussion of the methods of construction of sensitive air thermometers.

—S. Y.

The Estimation of Nitrogen in Nitrates by Kjeldahl's Method. M. Jodlbauer. Chem. Centralb. **17**, 433.

THE author finds that when benzoic acid is employed in place of sugar, as recommended by Asboth, the results obtained are far too low. The author bases his method on an observation by Kjeldahl, that in his process the nitrogen in amines is readily converted into ammonia. The nitric acid is first converted into a nitrophenol, and subsequently reduced by zinc dust. For this purpose, 0.2 to 0.5 gm. of the nitrate is treated with 20 cc. of concentrated sulphuric acid and 2.5 cc. of phenolsulphonic acid (100 cc. contain 50 grms. phenol), and then with 2 to 3 grms. of zinc dust and a few drops of a solution of platinum chloride. The action is complete in about four hours; it is more rapid when phosphoric anhydride is mixed with the sulphuric acid, but the flasks are then strongly attacked.—S. Y.

Potassium Permanganate as a Reagent for Alkaloids. H. Beckurts. Pharm. Zeit. **31**, 358.

IT has recently been shown by E. Giesel that potassium permanganate produces a violet precipitate of cocaine permanganate when added to a concentrated solution of the hydrochloride of that alkaloid. The author has studied the action of a ten per cent. solution of this reagent on other alkaloids, employing in each case a cold saturated solution of the hydrochlorides. Reduction and precipitation of manganese dioxide occurred with quinine, cinchonidine, cinchonamine, cinchonine, brucine, veratrine, colchicine, coniine, nicotine, aconitine, physostigmine, codeine and thebaine. The hydrochlorides of hyoscyamine, pilocarpine, berberine, piperine, strychnine and atropine were coloured red, and the reduction of the permanganate occurred gradually. A white crystalline precipitate of oxydimorphine was produced in a solution of morphine. Apomorphine was coloured a dark green. Nareine, narcotine and papaverine behave like cocaine, giving cherry-red precipitates, which, however, are less stable than the cocaine compound, and are destroyed by excess of permanganate.—S. Y.

Titration of Phosphoric and Arsenic Acids. A. Joly. Compt Rend. 1886, **102**, 316.

TO the acid solution a few drops of phthalein are added and then the baryta solution of known strength until a gelatinous precipitate is formed. This is a tribarium salt, which changes to the crystalline dibarium compound on standing, or by agitating. By a further addition of baryta solution a fresh gelatinous precipitate is formed, which changes similarly. This process is complete when a drop of baryta solution gives an intense and permanent red colouration.—J. B. C.

Estimation of Arsenic in Ores. G. W. Lehmann and W. Mager. Chem. News, **53**, 302.

THE finely-powdered substance is mixed with about six times its weight of equal parts of Na_2CO_3 and KNO_3 , fused and extracted with hot water and filtered. The filtrate is then acidified with nitric acid and boiled to expel carbonic and nitrous acids. To the cool solution silver nitrate is added, and then ammonia to neutral reaction. The silver arsenate is filtered, washed out with cold water until no silver is found in the washings, and the silver determined by Vollard's method. 108 parts of silver correspond to 25 parts of arsenic. In the case of metallic copper containing about one-tenth per cent. of arsenic, the following modifications are introduced:—100 grms. copper are dissolved in nitric acid, diluted to 500 cc. with water, and 100 cc. (20 grms.) taken for each determination.

A piece of iron sulphate about the size of a pea, is dissolved in nitric acid, added to the copper solution, and then ammonia in excess; the solution is well stirred and the precipitate of oxide of iron filtered hot, washed out with hot water, dried, removed carefully from the filter, mixed with the fusing mixture, etc. In another series of experiments the authors added lead and antimony, but found that their presence did not interfere with the results.—J. B. C.

New Method of Separating and Estimating Cadmium and Copper. L. Backelandt. Bull. Acad. Belg. **10**, 756—759.

THE separation is based on the fact that in the presence of glycerol, and by means of potash, cadmium is precipitated as hydroxide, whilst copper remains in solution. For quantitative purposes the precipitate of cadmium is first washed with potash, containing glycerol, to free it from copper, and then with hot water to remove alkali. The copper is precipitated from the filtrate by boiling with glucose, ignited and weighed as cupric oxide. Analytical data speak for the utility of the method.

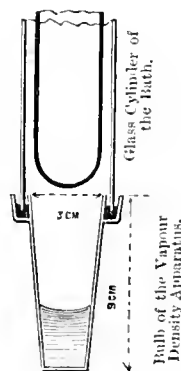
—D. A. L.

Witt's Filtering Apparatus. A. Bornträger. Ber. **19**, 1690.

IN referring to the filter recently described by Witt (this Journal, 1886, 391), the author states that he has employed a similar arrangement for several years in determining the insoluble residue and the potassium bitartrate in lees or tartar, according to the Warington-Grosjean method. The apparatus in question was originally devised by Casamajor (*Chem. News*, **32**, 45), and was subsequently modified by Grosjean (*J. Chem. Soc.* **35**, 341).—D. B.

Note on Vapour-density Determination. V. Meyer. Ber. **19**, 1861.

THE author states that in determining the vapour densities of substances boiling above 300° , it is necessary to employ, instead of the glass tubes with bulbs used as baths, jackets made of iron. As the bulbs of the glass baths so frequently break, after having been used for but a



short time, owing to the alternate heating and cooling to which the glass is subjected, an arrangement has been devised to obviate this defect. The heating agent, such as naphthalene, thymol, etc., is contained in a small cast-iron crucible, the rim of which is grooved in such a manner as to admit of the insertion of a glass tube, which is sealed in mercury. A glass protecting tube like this seldom cracks, and when it does it can easily be replaced by another. Reference to the drawing which accompanies the paper will render the appliance more intelligible.—D. B.

New Books.

THE METHODS OF GLASS-BLOWING. For the use of Physical and Chemical Students. By W. A. SHENSTONE, Lecturer on Chemistry in Clifton College. London: Rivington's, Waterloo Place. 1886.

SMALL 8vo volume, bound in cloth. Price 1s. 6d. Contains a Preface, Table of Contents, eighty three pages of subject matter, an Alphabetical Index, and forty-two woodcuts. Two pages of the eighty-three referred to form an Appendix, devoted to the subject of Glass-tubing. These two pages are illustrated with thirty cuts representing sections of glass-tubing of different sizes.

The little work is subdivided as follows:—GLASS-BLOWER'S APPARATUS: The Working-place; the Blow-pipe; the Bellows; Automatic blower; Blow-pipe flames. VARIETIES OF GLASS AND THEIR MANAGEMENT: Characters of good glass; Cleaning and preparing a tube; Presenting glass to the flame; Methods of working with lead and soft soda-glass respectively; Annealing. CUTTING AND BENDING GLASS. FORMING GLASS APPARATUS BEFORE THE BLOW-PIPE. MAKING AND GRINDING STOPPERS TO APPARATUS, ETC.: Cutting glass tubes; Bending glass tubes; Rounding and bordering the ends of tubes; Sealing; Choking or contracting the bore of a glass tube; Widening tubes; Piercing tubes; Welding, or uniting pieces of glass to each other; Blowing a bulb of glass; Making and grinding stoppers. MAKING THISTLE-FUNNELS, U-TUBES, ETC. COMBINING THE PARTS OF COMPLICATED APPARATUS. MERCURY AND OTHER AIR-TIGHT JOINTS. VACUUM-TAPS. SAFETY-TAPS. AIR-TRAPS. Electrodes; U-tubes; Spiral-tubes; Thistle-funnels; Closing-tubes containing chemicals; Modes of combining the parts of heavy apparatus; Mercury-joints; Modes of lubricating taps; Air-traps. GRADUATING AND CALIBRATING GLASS APPARATUS: To calibrate tubes, etc.; to divide a line into equal parts; to calibrate a burette; to calibrate tubes for measuring gases.

ANALYSIS TABLES FOR CHEMICAL STUDENTS. Adapted for the Advanced Stage of the Science and Art Departments' Examinations in Practical Inorganic Chemistry, and the Elementary and Advanced Stages of Practical Organic Chemistry. By R. L. TAYLOR, F.C.S., F.I.C., Teacher of Chemistry and Physics in the Central Higher Grade Board School, Manchester. London: Sampson Low, Marston, Searle & Rivington, Crown Buildings, 188, Fleet Street. 1886.

SMALL 8vo pamphlet-book, bound in limp cloth. Contains—Preface, Table of Contents, forty-four pages of subject matter, devoted to the systematic and tabular arrangement of the qualitative tests and methods of analytical separation of the more commonly occurring acids and bases. An Alphabetical Index at the end is usefully arranged to indicate at once, not the page merely, but the analytical table or group of tests.

THE GAS ENGINEER'S CHEMICAL MANUAL. By J. ALFRED WANKLYN. London: The Scientific Publishing Company, Limited, 22, Buckingham Street, Strand, W.C. 1886.

8vo VOLUME, strongly bound in cloth. Contains—Preface, Table of Contents, seventy-four pages of subject matter, and an Alphabetical Index. In the

text are interspersed four woodcuts. In the INTRODUCTORY CHAPTER the subjects treated of are—The extent of the Gas Manufacture in the United Kingdom, Sketch of the Operations carried on in Gas Works, Carbonisation—its Nature; Products from a ton of Newcastle Coals. CHAP. II. is devoted to COAL—its Nature, etc.; CHAP. III. to COAL-GAS; CHAP. IV., TAR; CHAP. V., AMMONIACAL OR GAS-LIQUOR; CHAP. VI., COKE; CHAP. VII., PURIFICATION OF GAS.

DIE CHEMIE DES STEINKOHLENTHEERS MIT BESONDERER BERÜCKSICHTIGUNG DER KÜNSTLICHEN ORGANISCHEN FARBSTOFFE. Von Dr. GUSTAV SCHULTZ. Zweite vollständig umgearbeitete Auflage. Erster Band. Die Rohmaterialien. Dritte Lieferung. Braunschweig, Druck und Verlag, von Friedrich Vieweg & Sohn. 1886. London: H. Grevel & Co., 33, King Street, Covent Garden.

IN the June number of this Journal, p. 393, the appearance of Parts I. and II. of this treatise was duly noticed. It was there stated that Part II., page 384, terminated with an account of Phenyl- α -naphthylamine. Part III. commences with an account of Phenyl- β -naphthylamine (CHAP. XII.), on page 385, and concludes, in CHAP. XVIII., page 608, with a special description of the Oxyquinolines. CHAP. XIII. is devoted to the Tertiary bases and substituted Ammonium compounds; CHAP. XIV. to the Pyridine bases with the Quinolines, Quinaldines, and Acridines; CHAP. XV., the Diazo compounds and Hydrazines; CHAP. XVI., the Azo compounds specially considered; CHAP. XVII., the Sulphonic derivatives and acids, their behaviour and modes of production; CHAP. XVIII., the Phenols, their modes of preparation and behaviour. This, of course, includes the Naphthols and their derivatives. Under the head of the Oxyquinolines, an account is given of the substance of the German patents devoted to the technological development of certain of them as febrifuges and anti-pyretics.

THE CHEMISTRY OF WHEAT, FLOUR, AND BREAD, AND THE TECHNOLOGY OF BREAD-MAKING. By WILLIAM JAGO, F.C.S., F.I.C., etc., Author of "A Confidential Report on Wheat and Flour Supply," "Inorganic Chemistry, Theoretical and Practical," etc. Brighton: William Jago, 138, Springfield Road. 1886.

VOLUME of large 8vo size, bound in cloth. Price 10s. 6d., post free to any address within Class A of the Postal Union. The book contains—Preface, Table of Contents, and 465 pages of text, with which ninety-one woodcuts are interspersed, and it concludes with a complete Alphabetical Index. Numerous valuable tables and tabulated results are also interspersed in the text. The subject matter is included in twenty-six chapters, which are devoted to the consideration of the following subjects:—The first and introductory one treats of the Principles of Chemistry and Physics; CHAP. II., Description of the Principal Chemical Elements and their Inorganic Compounds; III., Description of Organic Compounds; IV., The Microscope and Polarisation of Light; V., Constituents of Wheat and Flour—Mineral and Fatty Matters; VI., The Carbohydrates; VII., Transformation of the Carbohydrates; VIII., Albumenoids, or Proteids; IX., Fermentation (fermentation and fermentative changes are very fully treated in Chaps. IX. and XI.); X., Lactic and Putrefactive Fermentation; XI., Technical Researches on Fermentation; XII., Manufacture and Strength of Yeasts; XIII.,

Moulds and Fungoid Growths; XIV., Physical Structure of Wheat Grain; XV., Chemical Composition of Wheat; XVI., Chemical Composition of Flour and other Milling Products; XVII., Bread-making; XVIII., Modern Baking Machinery and Appliances; XIX., Analytical Apparatus; XX., Commercial Testing of Wheats and Flours; XXI., Determination of Mineral and Fatty Matters in Wheats and Flours; XXII., Acidimetry and Alkalimetry; XXIII., Soluble Extract, Acidity and Albumenoids; XXIV., Estimation of Carbohydrates; XXV., Bread Analysis; XXVI., Adulteration.

Monthly Patent List.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

- 10806 J. H. Lorimer, London. Improvements in drying machines. Complete specification. August 24
 10818 A. Harrison, Barrow-in-Furness. An improved radiating hood cover for soaking pits. August 25
 10880 T. D. Williams, London. Improvements in amalgamating apparatus. August 25
 10883 F. W. Browldow, Manchester. Improvements in or applicable to filters. August 26
 10990 S. S. Bromhead, London. From A. Legend, France. "The Gyropulsator" or fluid agitator. August 28
 11025 S. Hoyle, Acerington. Improvements in apparatus for preventing corrosion of, preventing incrustation in, or facilitating the removal of incrustation from steam and other boilers. August 30
 11063 T. Smith, Newcastle-on-Tyne. Improvements in apparatus for burning liquid fuel for steam boilers and other purposes. August 31
 11070 J. A. Walker. See Class II.
 11079 J. E. Slack, London. Improvements in the construction of the roofs of furnaces, and in bricks to be used therefor. August 31
 11169 J. Williamson, Glasgow. Improvements in filter-presses. September 2
 11214 A. W. Anderson, London. Improvements in filter-presses. September 1
 11304 C. Bird, Halifax. Improvements in filters for filtering water for manufacturing purposes. September 6
 11335 R. Romaine, Liverpool. Improved apparatus for condensing steam or other vapour by the cooling action of an induced current of air. September 6
 11339 J. Sturgeon, Birmingham. Improvements in shut-off valves for pipes or mains, more especially applicable for compressed air mains. September 6
 11383 J. L. Peslin, London. Improved smoke consuming furnace. Complete specification. September 7
 11116 R. Scott, Newcastle-on-Tyne. Improvements in and connected with furnaces. September 8
 11195 J. F. Schnell, Manchester. Improvements in motive power engines actuated by an explosive mixture of air and gas, or by an explosive mixture of air and the vapour of a hydrocarbon or hydrocarbons. September 9
 11579 M. Slade and E. J. T. Digby, London. Improvements in the manufacture of crucibles. September 11
 11589 D. K. Clark, London. Improvements in filter-presses. September 11
 11654 A. Baird and M. B. Baird, Glasgow. Improvements in air compressors and receivers. September 11
 11711 J. E. Brown, Brighton. Improved means of consuming smoke in steam boiler furnaces. Complete specification. September 15
 11731 W. H. Twine, A. M. D. Churchill, and H. J. Honnor, London. Improvements in cocks and valves especially adapted for steam, hot or cold water, or other fluids under high pressure. Complete specification. September 15
 11763 J. C. Brentnall, Manchester. Improvements in furnace bars. September 16
 11896 W. H. Ack, London. Improvements in refrigerating apparatus. Complete specification. September 18

COMPLETE SPECIFICATIONS ACCEPTED.*

1885.

- 10151 F. Elmore. Manufacture of metal pans, cylinders, boilers, containers, etc. September 3
 12612 E. J. Jones and T. Johnson. Taps and valves for drawing off liquids. August 21
 12773 A. F. Vuylsteke. Filter-presses. August 21
 13772 Furnace blast apparatus for economising fuel, consuming smoke, and increasing power of steam boilers. September 3

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

- 13071 W. Armitage, Sheffield. Apparatus for supplying air to furnaces above the fuel. September 11
 13301 R. J. Billington and R. M. Deeley, jun. Improvements in blast pipes. September 3
 13631 H. J. Allison. From R. P. Ambler and H. Dietz. Apparatus for burning liquid fuel. August 24
 13859 J. G. Robinson. Regenerative or recuperative furnace applicable to gas, iron, steel, glass or other furnace. September 11
 11081 C. S. Madan. Injectors for raising fluids and feeding steam boilers. September 11
 11412 F. Siemens. Method for lining furnaces. September 17

1886.

- 1352 R. Scott. Improvements in furnaces, whereby chimneys are dispensed with, the heating properties of fuel increased, and smoke consumed. September 21
 2854 G. Teidman. Filter taps. September 3
 9312 B. D. Healey. See Class XVII., B.
 5562 E. Bollig and G. O. Heyne. Apparatus for eliminating air, gases, and carbonate of magnesia from feed water purified by magnesia. September 3
 9838 E. C. Allam. Improvements in filters. August 31
 10169 G. A. Hagemann. Improvements in furnaces. September 10

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

- 10891 W. Finlayson, Glasgow—From R. Hargrave Martin, United States. Improvements in manufacturing or preparing asbestos for use as a non-conductor of heat and otherwise. August 26
 10969 A. Brin and L. Q. Brin, London. Improvements in means for heating steam boilers and the like, and for decomposing steam and burning its constituent gases for the production of light and heat generally. August 27
 10983 H. Montgomerie, Newcastle-on-Tyne. Collecting and using the waste heat from steam boilers. August 28
 11070 J. A. Walker, London. An improved means of obtaining greater heat and generating steam more rapidly in boilers. August 31
 11161 F. L. Rawson and W. S. Rawson, London. Improvements relating to the production of light by the incandescence of refractory materials. September 1
 11287 A. Paget, London. Improvements in the manufacture of what are known as mantels, used in what is called incandescent gas lighting. September 4
 11300 A. C. Thomson, Glasgow. Improvements in apparatus for washing or treating mineral oils with acids or alkalis. September 6
 11358 J. Orchard and H. Lane, London. Improvements in means and apparatus for producing and utilising light and heat arising from the combustion of gases. September 7
 11496 J. F. Schnell, Manchester. Improvements in and in apparatus for impregnating or charging air with the vapour of a hydrocarbon or hydrocarbons for actuating motive-power engines, and for certain other purposes. September 9
 11497 J. F. Schnell, Manchester. Improvements in and in apparatus for impregnating or charging air with the vapour of a hydrocarbon or hydrocarbons for illuminating, for actuating motive-power engines, and for heating and certain other purposes. September 9
 11538 J. Neil, Glasgow. Improvements in or connected with the burning of hydrocarbon or mineral oils and other such liquid fuel in steam boiler or other furnaces, and in apparatus therefor; also applicable for other heating and lighting purposes. September 10
 11632 E. Eich, H. Sepulchre, and J. Pasque, London. Improvements in the manufacture of compounds for use as fuel. September 13
 11651 R. Howson and W. P. Ingham, Middlesbrough-on-Tees. An improvement in gas producers. September 14
 11681 R. Pringle, London. A process of and apparatus for obtaining purified carbon from soot and other similar carbonaceous products of combustion. September 14
 11691 G. R. Cottrell, London. Method of and apparatus for carburetting and mixing gas and air. Complete specification. September 14
 11701 J. Murrie, Glasgow. An improved method of generating vapour and of liquefying vapour so or otherwise generated. September 15
 11767 J. Murrie, Glasgow. Improvements in generating and in accumulating and applying the energy of elastic vapour, and in the arrangement of apparatus therefor. September 16
 11829 P. M. Justice, London. From A. P. Rockwell, United States. Improvements in carburetting compounds. Complete specification. September 17
 11833 J. M. Turnbull, Glasgow. Improvements in the manufacture of gas from mineral oil, and in apparatus therefor and connected therewith. September 17

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 11661 J. Foord and W. W. Paddon. Apparatus for carburetting air for production of light and heat. August 27
 11713 H. Howell. Apparatus for making illuminating gas from volatile hydrocarbons. August 31

12638 H. Harris. Purification of gas in its passage from the meter to the service pipes. September 3
12721 J. L. Balfour and J. Lane. Manufacture of illuminating gas and volatile liquid hydrocarbons. August 21
13061 J. A. Yeadon and R. Middleton. Apparatus for the manufacture of artificial fuel. September 10
13067 J. A. Yeadon and R. Middleton. Apparatus for the manufacture of artificial fuel. September 10
13096 A. Morton and J. Fyfe. Furnaces for distilling and refining mineral oils. August 31
13147 G. A. Sweetser, D. W. Bell, and W. Rohm. Manufacture of candles and apparatus therefor. September 7
13488 T. G. Marsh. Gas lighting and heating. September 7
11269 P. Tarbutt. Method of effecting combustion of liquid fuel. September 7

1886.

2498 G. Beard. Heating feed water, and utilising the waste heat of "low heating furnaces." September 16
6059 J. Holden. Use of liquid fuel as auxiliary to solid fuel in certain boilers. August 31
6617 E. Mansfield. Apparatus for manufacturing gas from oil. August 24
9116 J. Roberts. Process and apparatus for manufacturing heating and illuminating gas. August 21
9167 H. Süß. Magnesium lamps. August 21

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, ETC.

APPLICATIONS.

10910 C. L. Remy and C. A. Erhart, London. An improved process for obtaining anthracene from substances containing anthracene. August 26
10957 A. Nikiforoff, London. Improvements in the manufacture or production of benzol, anthracene, naphthalene, and other products from naphtha and naphtha residues. August 27
11131 J. Jones, Edinburgh. Improvements in retorts for the destructive distillation of shale, coal and other bituminous substances. September 1
11301 A. C. Thomson, Glasgow. Improvements in distilling or obtaining oil from shale or other oil-yielding minerals, and in apparatus therefor. September 6
11345 J. A. Yeadon and R. Middleton, Leeds. Improvements in retorts or furnaces for the distillation of coal, shale and other materials. September 7
11581 T. Rouet, London. Improvements in the construction and arrangement of mechanical retorts for the destructive distillation or the revivification of animal, vegetable and mineral matters. September 11
11702 J. Jones, Edinburgh. Improvements in retorts for distilling shale, coal and other bituminous substances. September 15

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

11356 O. Imray, London. From H. M. Baker, United States. Manufacture of a resorcin blue. Complete specification. September 7
11822 W. R. Hodgkinson, London. From L. Limpach, Germany. Improved process or method for effecting the separation of isomeric xylinines from commercial xylinine in a pure state for the production of colouring matters. September 17

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

14962 H. H. Lake. From A. Leonhardt & Co. Manufacture of colouring matters. August 31
15206 P. Jensen. From The Actiengesellschaft für Anilinfabrikation. Production of mixed azo colours. September 14

1886.

9176 L. J. B. A. J. Bouillet. Manufacture of ultramarine, and apparatus therefor. August 24
9751 L. Schad. Production of a bluish-black colour. August 31

V.—TEXTILES, COTTON, WOOL, SILK, ETC.

APPLICATIONS.

10829 W. R. Lake, London. From C. Orlay, Italy. Improvements relating to means for rendering textile fabrics and other substances impermeable, or for protecting them from injury by moisture. August 24
11370 E. Tremblay and A. Dietus, London. Improvements in the process of washing wool, and apparatus therefor. September 7
11427 R. Punshon, London. An improved method for waterproofing cloth, paper, linen, cotton goods, and other suitable materials. September 8

11601 D. Hall, J. H. Kay, and T. Wagstaffe, Manchester. An improved oven for drying raw cotton and other substances, chiefly for testing purposes. September 13
11795 E. Donner and E. Corssel, London. Improvements in the treatment of cocoons of silk preparatory to unwinding the silk therefrom. Complete specification. September 16

COMPLETE SPECIFICATION ACCEPTED.

1885.

13391 E. H. Hargraves. Method and apparatus for treating cotton, etc., to produce therein greater softness or flexibility. September 10

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

10842 J. Gibson and F. M. Gibson, Glasgow. Improvements in bleaching fibrous materials. August 25
10933 E. Sutcliffe and G. E. Sutcliffe, Halifax. Improvements in the method of and apparatus for bleaching, dampening, and dyeing loose fibre, yarns, threads, or other fibrous materials. August 27
10998 B. J. B. Mills, London—From F. V. Serikoff and W. E. Smith, Russia. An improved process of and apparatus for bleaching cotton, linen, and other textures and materials. August 28
11161 W. E. Heys, Manchester—From H. Danzer, A. Simian, and De Marcien, France. A new or improved method of dyeing and finishing textile fabrics, simultaneously without immersion. September 2
11207 M. Hilton, Prestwich. Finishing cotton, linen, or union cloth grey, bleached, dyed, or printed. September 3
11302 H. Ledger, Leek. Improvements in bleaching fibrous materials, textile fabrics, also paper pulp of vegetable origin, and the recovery of useful products therefrom. September 6
11581 W. G. Young, London. An improved mordant for dyeing cotton and other fibrous substances. September 11
11730 H. J. Hadden, London—From A. Henry, France. Improvements in dyeing. September 15

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

13029 T. Salt. Apparatus for dyeing or treating woven fabrics. August 24
13214 W. H. Lake—From V. Gaillot. Improvements in dyeing silk, wool, etc. August 31
13790 T. Holliday. Production of azo-colours on cotton or other vegetable fibre. September 11
14031 H. H. Ainsworth and E. B. Mauby. Apparatus for scouring, washing, dyeing, etc. September 14
14637 J. C. Mewburn—From La Société Leblois, Piceni, et Cie. Bleaching cotton, and apparatus therefor. September 3

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

10798 H. J. P. Sprengel, London. An improvement in the production of sulphuric acid. Complete specification. August 24
10868 J. Lea and H. R. Hammond, London. Operating on zinc ore for producing chlorine, also zinc, and the utilisation of the said zinc for coating metals galvanically. August 25
10955 J. I. Watts and W. A. Richards, Liverpool. Improvements in the manufacture, purification, or separation of sodium bicarbonate. August 27
11152 B. J. B. Mills, London—From the Verein für Chemische Industrie, Germany. An improved process of producing muriatic acid. September 1
11461 H. Clay Ball, Liverpool. A new or improved manufacture of and process for making sodium, and apparatus employed therein. September 9
11472 G. E. Vaughan, London—From A. E. Schwirthe, France. Improvements in the manufacture of sulphate of soda, and in obtaining ammonia. September 9
11548 J. M. Collett, Gloucester. Improvements in the manufacture of sodium sulphates. September 10
11891 A. Brin and L. Q. Brin, London. Improvements in the manufacture of bleaching liquid. September 18

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

11219 F. G. Riley. Apparatus for generating carbonic acid gas. August 24

1886.

7395 P. M. Justice—From H. Y. Castner. Manufacture of sodium and potassium. August 24
10009 H. H. Lake—From R. de Montgela. Apparatus for the manufacture of chlorine gas. September 21

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

- 11233 H. Boulton, London. An improvement in the process of making the description of pottery known as Bristol stone-ware. September 3
- 11262 C. J. Allport, London. The manufacture of cullet for making glass and similar silicious products from granulate, and similar forms of granite and felspar. September 4
- 11629 C. J. Heaton, London. Improvements in the manufacture of ornamental cloisonné work, specially applicable to decorative building purposes, and to vases, jewellery, and other articles. Complete specification. September 13
- 11769 R. A. Gibson and W. J. Boorer, London. Improvements in gas-heated ovens and kilns for firing tiles, porcelain vases, bending and firing glass, painted and stained, and for other purposes. September 16
- 11870 R. Kelsall and W. Lee, Longport. Improvements in machinery for drying pottery ware. September 18

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 10378 G. J. Atkins. Furnace for firing stained or painted glass and enamels, etc. August 31
- 12814 J. Wilson. Preparing clay for potters' use. August 21
- 11462 J. M. Beurel. Manufacture of articles of glass, porcelain, earthenware, etc. August 31

1886.

- 8022 M. Schreiber. Annealing glass tubes, cylinders, hollow-ware, etc. September 3
- 10019 E. Walsh, jun. Manufacture of rolled plate glass. September 21

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

- 10788 A. Smith and J. Robertson, Glasgow. Improvements in making Portland cement, and in apparatus therefor. August 21
- 10829 C. J. Dobbs, London. An improved manufacture of scoria paving blocks. August 24
- 11023 F. Wicks, Glasgow. An improvement in paving, flooring, or building material. August 30
- 11079 J. E. Slack. See Class I.
- 11091 J. C. Anderson, London. Method of, and apparatus for, manufacturing bricks, tiles, etc. Complete specification. August 31
- 11108 P. P. de la Sala, London. Improvements in the treatment and application of wood to the covering of surfaces. August 31
- 11144 F. Dixon, London. Improvements in the preservation of wood with special regard to its application for sleepers and paving purposes. September 1
- 11208 H. Wilson. See Class XVII. A.
- 11303 E. Larsen, Liverpool. Improvements in the manufacture or preparation of furnace slag, and of cement partly made therefrom. September 6
- 11377 W. Bull, London. Improvements in and connected with the manufacture of tiles for roofing or other purposes. Complete specification. September 7
- 11613 H. Macevoy, H. Holt, and W. Wilders, Northfleet. Improvements in the manufacture and burning of Portland cement. September 13

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 12908 S. Pitt—From L. Pillivuyt. Lime cement, for production of cements, mortars, hydraulic concretes, and artificial stone. August 27
- 13132 R. Bennett and H. Peet. Composition for use in mural decorations. September 10
- 13595 A. G. Brookes—From R. A. Meyn and J. F. O. Arnack. Manufacture of artificial stones or marbles. September 10
- 13766 W. H. Lindsay. Fire-proof floors. September 14

1886.

- 9408 H. H. Leigh—From B. Dubois. Method of constructing ornamental masonry columns. September 10

X.—METALLURGY, Etc.

APPLICATIONS.

- 10789 C. While, Darlington. Improvements in hot banks for iron and steel works. August 21
- 10822 A. Brin, London. Improvements in the manufacture of iron and steel. August 24
- 10823 J. Y. Johnson, London—From La Compagnie Anonyme des Forges de Chatillon et Commeny, France. Improved means for tempering or hardening metal. August 21
- 10868 J. Lea and H. R. Hammond. See Class VII.

- 10936 C. G. Jordan, J. E. Jordan, and F. Herbert, Newport. Improvements in core bars. August 27
- 11082 W. Annable, Sheffield. Improvements in the manufacture of armour plates. August 31
- 11211 C. J. L. Leffler, Sheffield. A method of reducing aluminium ore or alumina into metal or into metallic alloys, when in combination with other ores or oxides of metals. September 3
- 11312 D. G. Fitzgerald. See Class XVIII.
- 11201 R. K. Boyle, London. Improvements in and apparatus or means for electroplating. September 4
- 11385 F. E. Hainley, London. An improved method of utilising the expansion and contraction of metals due to changes of temperature. Complete specification. Sept. 7
- 11412 R. L. Short, J. Short, and J. B. Short, West Hartlepool. A real safety lamp for the use of miners. September 8
- 11413 M. Settle, Manchester. Improvements in electric safety lamps for use in mines. September 8
- 11529 W. Banks, London. A new or improved miner's safety lamp. September 10
- 11551 J. Morley and W. Gaskill, London. An improved method of manufacturing homogeneous, seamless or endless steel, iron or other tubes, rings, etc., suitable for light or heavy ordnance, engine, propeller, and other shafts, hydraulic cylinders, pumps, columns, locomotive and other tyres, etc. September 11
- 11600 A. E. Tucker, Smethwick. Improvements in the linings of copper, lead and other similar furnaces, as well as steel or Siemens furnaces and steel converters. September 13
- 11617 C. Shaw, Sheffield. An improved method of and apparatus for running the castings in steel or other suitable metal, so as to render them free from air or pin-holes. September 13
- 11756 S. Gratrix, Manchester. An improvement in apparatus for the manufacture of lead and other metal pipes. September 16
- 11776 J. E. Baugh and C. Hinksman, London. Improvements in fuel-saving quiescent furnaces for economically generating chlorine and concentrating gold, silver, copper, and other metals from pyrites and ores generally, together with the process in connection therewith. September 16
- 11787 H. J. Coles, London. Improvements in rock drills. Complete specification. September 16
- 11816 A. Brin and L. Q. Brin, London. Improvements in the manufacture of metallic oxides. September 17
- 11817 J. S. McArthur, R. W. Forrest, W. Forrest, and G. Morton, Glasgow. Improvements in obtaining gold, silver, and other noble metals from ores or other compounds. September 17
- 11876 S. Thompson and R. Thompson, Newcastle-on-Tyne. Improvements in boring machines for coal, stone, and other materials. September 18

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 10024 R. Oxland and C. Oxland. Treatment of ores, etc., containing sulphur for extraction of metals, etc. August 21
- 12066 H. Baxter. Crucible cast-steel waggon cradles. September 7
- 12101 S. Hannah. Steel ships' and other steel plates. September 7
- 12795 T. Turner. Moulds for casting ingots of metal. August 21
- 13169 R. Hadfield. Manufacture of steel and other projectiles. September 10
- 13260 L. Kleeman. Furnace for smelting ores, etc., containing zinc. August 31
- 13275 W. Deighton. Furnaces, apparatus and appliances for melting and treating ores, metals, etc. August 31
- 13574 J. Guest. Rolling plates, sheets, strips, etc., of iron and steel. September 11
- 13763 W. H. Lindsay. Manufacture of corrugated plates of metal. September 11
- 13892 C. Cherry. Processes and apparatus for the treatment of ores. September 11
- 13982 W. F. Richards. Production of metallic zinc, and recovery of ammonia from the products resulting from the galvanisation of iron. September 17
- 11136 J. Lewthwaite. Producing malleable castings. Sept. 21
- 11113 F. Siemens. Regenerative gas furnace for continuous reduction of iron ore. September 17
- 11235 R. Gratzel. Production of aluminium and aluminium bronze. September 17
- 11411 R. Heathfield. Utilising waste products obtained in galvanising iron.
- 13357 S. Thomas. Finishing tin and terne plates. Sept. 7

1886.

- 3540 A. M. Clark—From La Société Scola et Ruggieri. Electric fuse for blasting purposes. September 17
- 4369 T. H. Johns. Process and machinery for cleaning tin and terne plates. September 3
- 9663 M. R. Moore. Machines for making sand moulds for casting metals. August 27
- 9806 C. A. von Weisbach. Obtaining compounds of the rarer metals from their carths.
- 9926 H. J. Allison—From J. Robertson and J. Hardie. Hydraulic lead presses for coating wire and cable with lead. September 3
- 10605 W. R. Lake—From R. de Montgelas. Extracting aluminium from chlorides of the same, and of aluminium and sodium. September 21
- 10606 W. R. Lake—From R. de Montgelas. Extracting aluminium from its chlorides. September 21

XI.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

- 10833 N. Coste, London. Improvements in apparatus for expressing oil from oleaginous substances, and for similar purposes. August 24
- 10968 A. Brin and L. Q. Brin, London. Means for bleaching and disinfecting animal, vegetable, or mineral oils and fatty matters. August 27
- 11068 J. F. Johnstone, London. A new mode or means of extracting oil and water from waste fish blood. August 31
- 11069 A. H. Allen and B. Nickels, Sheffield. The treatment of spent soap leys, crude glycerine and other solutions containing glycerine, for the removal of impurities and the recovery of glycerine and other products therefrom. Aug. 31
- 11136 O. E. Pohl, Liverpool. An improved anti-heating lubricant. September 1
- 11138 T. Berliner, Berlin. Improvements in a method and apparatus for extracting the fat from bones, etc. Complete specification. September 1
- 11192 H. W. Langbeek, London. A process for the treatment of wool fat to produce unguent material therefrom. Sept. 2
- 11560 J. E. Quayle, Liverpool. An improved washing powder. September 11
- 11741 W. Graff, London. Improvements relating to the separation of fat and fatty acids from compounds containing the same. September 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 11380 R. Ross. Manufacture of soap for toilet and cleansing purposes. September 21

1886.

- 9591 J. Thomson. An improved antiseptic soap. Sept. 7
- 10226 H. H. Lake—From N. J. Clute, P. B. Rose, and J. M. Aubery. Manufacture of soap. September 10

XII.—PAINTS, VARNISHES, AND RESINS.

APPLICATIONS.

- 10960 M. Benedictus, London. Manufacture of material for the removal of old paint. August 27.
- 11493 A. McLean and R. Smith, London. Improvements in the preparation of colours for artistic purposes. September 9
- 11491 A. McLean and R. Smith, London. Improvements in the manufacture of pigments. September 9
- 11589 F. Maxwell Lyte, London. Improvements in the manufacture of pigments. September 18
- 13115 J. Haylor, H. S. Read, and H. G. Percival. Apparatus for the manufacture of white lead. August 31
- 13159 J. Pointon. Anti-fouling and anti-corrosive paints or compositions. August 31.

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 10538 A. J. Ward. Compound for manufacture of pigments, applicable also in place of white lead. September 10
- 13396 E. Jackson. Composition or paint for coating ships' bottoms. September 3
- 13891 J. B. Freeman. An improved white pigment. Aug. 31
- 14128 J. B. Spence. Preparation of materials for making paint. September 17

1886.

- 9027 E. Schaal. Production of resin acid esters suitable for the manufacture of varnishes and lacquers. August 24

XIII.—TANNING, LEATHER, GLUE AND SIZE.

APPLICATIONS.

- 10987 J. Townsend, Glasgow. Improvements in treating hides or skins. August 28
- 11005 C. Wagner, jun., London. Improvements in machines for skiving or sharpening leather. August 28
- 11031 E. Edwards, London—From H. Hobuss, Germany. An improved process for treating the skins of oxen or cows to produce an imitation hog or pig skin, or leather. August 30

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

- 7145 A. H. Mangin. Product for depilating and preserving hides. September 11
- 7692 W. P. Thompson—From J. W. Fries. Tanning and currying hides and skins. August 24
- 8143 T. N. Ashman. Composition for treating leather. September 7.

XIV.—AGRICULTURE, MANURES, ETC.

APPLICATIONS.

- 11620 W. H. Nevill, London. Improvements in the treatment of excreta or pail-stuff, in order to render it available as manure. September 13

- 11841 A. Blackie, London. An improved method of applying arsenic and sulphur for destroying animal and vegetable parasites and preventing their attacks. September 17
- 11883 J. H. Barry, London. A treatment of excreta and sewage sludge for production of manure. Complete specification. September 18

XV.—SUGAR, GUMS, STARCHES, ETC.

APPLICATIONS.

- 10873 A. Rossi and C. Hellfrisch, London. A process for the manufacture of gum. August 25
- 10911 P. Laberie, London. Improvements in apparatus for evaporating the juice of beetroot, sugar-cane, and other juices or liquids. August 26
- 11048 F. Candy, London. Improvements in the manufacture of materials for use in purifying and decolorising liquids and solutions. August 30
- 11451 S. Vickess, Liverpool. Improvements in apparatus for making lump sugar. September 9
- 11557 E. M. Knight, Halifax. Improvements in the manufacture of liquid gum for mounting photographs, lithographic printing, commercial and domestic use. September 11
- 11861 T. C. A. Currie, London. Improvements relating to the moulding of sugar, and apparatus therefor. September 17

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 10936 H. J. Haddon—From L. E. Vial. Removal of gum from grass and plants. August 27
- 13792 A. Crum Ewing—From T. Shields. A combined eliminator and filter for treating sugar-cane juice and other liquids. September 11

1886.

- 9992 A. G. Wass. Utilisation of lime, etc., impregnated with saccharine matter. September 17

XVI.—BREWING, WINES, SPIRITS, ETC.

APPLICATIONS.

- 11522 J. E. Guild, London—From D. R. S. Galbraith, New Zealand. A new or improved potable malt liquor. September 10
- 11559 J. Crawford, Glasgow. Improvements in apparatus for raising or forcing beer and other liquids. September 11
- 11588 N. Harris, London—From J. Farinaux, France. An automatic apparatus for producing carbonic acid or other gas under constant pressure, specially applicable to raising beer and the manufacture of aerated liquids. September 11
- 11627 E. F. Daniel, London. Improvements in utilising the otherwise waste heat of hot water which has been used for cask washing in breweries, or for the like. September 13

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 9328 J. P. Jackson. Machines for charging liquids with carbonic acid under pressure. September 3
- 12136 E. R. Southby and W. T. Ramsden. Method of bottling and preserving beer, etc., and apparatus therefor. September 7
- 12294 T. Webb. Distilling spirits by heating wash before its entry into distilling apparatus. August 27
- 13006 H. J. H. King. Automatically regulating the temperature of malt and hop kilns, and indicating the same. September 17

1886.

- 9630 L. Béchaux. Distillation and rectification of alcoholic and other liquids. September 10

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, ETC.

APPLICATIONS.

A.—CHEMISTRY OF FOODS.

- 10903 P. Jensen, London—From K. G. Dahl, Norway. Improvements in preserving milk, and in vessels or containers therefor. August 26
- 10938 H. J. Haddon, London—From S. Heumann and E. Heimann, Austria. Improvements in or connected with the preservation of meat. August 27
- 10995 H. P. Madsen, London. Improvements in the utilisation of blood from slaughterhouses in and for the preparation of food and drink for man and cattle, and other animals. Complete specification. August 28
- 11128 A. Drummond and J. McAdam, jun., Glasgow. Improved apparatus for heating and cooling milk, and for facilitating the separation of the cream therefrom. September 1

- 11208 H. Wilson, Stockton-on-Tees. Extraction of moisture from timber, grain, fibrous material, textile, and other fabrics; also for seasoning timber, and preserving articles of food, prints, etc., at low temperatures. September 3
- 11732 A. B. Lester and A. Meaby, London. A method of preparing malted wheat, oats, and other cereals (barley excepted), and of employing them in the manufacture of bread and other food, and a method of preparing a special ferment. Complete specification. September 15
- 11835 G. F. Redfern, London—From L. J. Eriksson and E. E. R. Nordling, Sweden. The manufacture of dry rennet, and process therefor. September 17

B.—SANITARY CHEMISTRY.

- 11165 J. B. Hannay, Glasgow—From R. W. E. MacIvor, New South Wales. Improvements in treating night soil, and in apparatus therefor. September 2
- 11366 W. P. Thompson, Liverpool—From V. D. Anderson, United States. Improvements in apparatus for drying oil and the like. Complete specification. September 7
- 11409 A. Forrest and W. Welsh, Manchester. Improvements in machines for drying and powdering blood, town sewage, or other material. Complete specification. September 8
- 11461 V. L. E. Miller, London. The extraction of the water, liquid or volatile elements from sewage, brine or other fluid or partially fluid substances, either chemical solutions or mechanical mixtures. September 9
- 11620 W. H. Nevill. See Class XIV.
- 11820 G. H. Leane, London. The application and use of carbon for the compression of sewage sludge. Complete specification. September 17
- 11870 C. H. Geison, London. Improvements in filtering and cleaning water, preferably waste water of factories and other industrial establishments. September 17

C.—DISINFECTANTS.

- 11011 J. W. Knights and W. D. Gall, London. Improved manufacture of disinfecting powder. August 28

COMPLETE SPECIFICATIONS ACCEPTED.

A.—CHEMISTRY OF FOODS.

1885.

- 12917 H. C. Johnson. Dehydrating and refrigerating air for transportation of meat, etc., and apparatus therefor. August 27

1886.

- 4062 J. G. Johnson—From C. Marchand. Treating rancid butter, etc., for purifying, flavouring, and mixing same, and apparatus therefor. September 10
- 10318 A. H. Reed—From R. Ellin. Production of evaporated milk. September 17

B.—SANITARY CHEMISTRY.

1885.

- 13750 J. W. Lester and the Native Guano Co. Preparation of agents to be used in treatment of sewage, etc., and treatment of such sewage, etc. September 7

1886.

- 9342 B. D. Healey. Improvements in refuse furnaces and apparatus therefor, partly applicable to other furnaces. September 14

XVIII.—ELECTRO-CHEMISTRY.

APPLICATIONS.

- 10824 J. T. Armstrong, London. Improvements in the construction of electrical batteries, and in the method of and means, materials, and appliances for working the same. Complete specification. August 24
- 11001 W. H. Beck, London—From La Société Perreux-Lloyd et Bève, France. An improved galvanic battery. Aug. 28
- 11010 E. Andreoli, London. A new secondary battery. August 30
- 11101 T. J. Jones and W. H. Tasker, London. Improvements in secondary batteries. August 31
- 11159 F. C. Hills, London. Improvements in secondary batteries or electric accumulators. September 1
- 11239 H. Carter, London. An improved arrangement of electric battery, with means for regulating the submersion or withdrawal of the negative electrodes. September 3
- 11242 D. G. Fitzgerald, London. Improved means for effecting the electro-chemical generation of chlorine in metallurgical operations for the extraction of gold from its ores and for other purposes. September 4
- 11487 S. Farbaký and S. Schenek, London. Improvements in the manufacture of positive pole-plates for secondary batteries or accumulators. September 9
- 11634 J. C. Sargeant and R. E. George, London. Improvements in instruments for the measurement of electric currents. September 13
- 11653 R. H. Courtenay, London. Improvements in voltaic electric batteries. September 14

- 11823 P. Bailly, London. Improvements in primary and secondary batteries. Complete specification. September 17
- 11831 C. E. O'Keenan, London. An improved automatic primary battery. September 17
- 11910 D. Cook, Glasgow. An improved electric furnace. September 20
- 11917 D. Cook, Glasgow. Apparatus for measuring currents of electricity. September 20
- 11919 D. Cook. Apparatus for generating, integrating, and automatically regulating currents of electricity. Sept. 20
- 11920 D. Cook. Dynamometer for measuring the power absorbed by dynamo-electric machines or the work being done by electro-motors. September 20

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 11876 T. V. Hughes and C. R. Chambers. Manufacture of carbon filaments. September 10
- 12724 J. E. Liardet. Galvanic or primary batteries. Aug. 21
- 13443 S. P. Thompson. Constant current dynamo-electric machines. September 11
- 13639 W. Maxwell. Manufacture of carbon filaments. September 21
- 11612 A. Dun and F. Hasslacker. Improved galvanic battery. September 10

1886.

- 1845 P. Bailly. Manufacture of active electrodes, and their application to primary and secondary batteries. Sept. 17
- 10644 A. Millar. Electrodes for secondary batteries. September 21

XIX.—PAPER, PASTEBOARD, ETC.

APPLICATION.

- 11293 W. B. Nation, London. Improvements in the treatment of vegetable fibres for paper-making and other useful purposes. September 4

COMPLETE SPECIFICATION ACCEPTED.

1886.

- 10267 J. B. Scammell. Paper for cigarettes. September 11

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 11846 A. Brin and L. Q. Brin, London. Improvements in means for the manufacture or production of ozone. Sept. 17
- 11002 A. G. Brookes—From T. S. Nowell. Acid bases for beverages and tonics. September 17

XXI.—EXPLOSIVES, MATCHES, ETC.

APPLICATIONS.

- 11043 D. Lindo, London. Improved method of making wax and other matches to light pipes or cigars in the open air, and for other purposes. August 30
- 11140 R. H. Punshon, London. Explosive compounds. September 1
- 11197 T. Nordenfelt, London. Improvements in fuzes for projectiles. September 2
- 11276 D. Campbell and G. L. Schnitz, London. Improvements in submarine mines. September 4
- 11414 L. Sanderson, London. Improvements in torpedoes. September 8
- 11437 W. Holmstrom, London. Improvements in machinery for applying igniting material to match-sticks or splints. Complete specification. September 8

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 12778 O. Inray—From R. Bernstein. Manufacture of granular nitro-cellulose. September 17
- 12837 H. Inray—From H. Dulitz. Manufacture of an explosive compound. September 17
- 11052 O. Bowen. Manufacture of gunpowder. Sept. 17

XXII.—GENERAL ANALYTICAL CHEMISTRY.

COMPLETE SPECIFICATION ACCEPTED.

1885.

- 12074 J. G. Lorrain. The composition and decomposition of compound or complex bodies. September 21

THE JOURNAL

OF THE

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FOR ALL INTERESTED IN CHEMICAL MANUFACTURES.

No. 10.—VOL. V.

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NOTICES.

The supply of copies of the Journal for January, 1882, being now exhausted, the Secretary would be glad to receive communications from members possessing extra copies of that number, in good condition, with a view to purchase.

Should sufficient applications for complete sets be received, the number will be reprinted.

The number of Subscriptions at the old rate which are being received from members for the year 1887, renders it necessary to call attention to the fact that, under the provisions of the Bye-Laws, as revised at the last General Meeting, the Annual Subscription to the Society will be in future 25s., instead of One Guinea as heretofore.

Arrangements are being made whereby those who have given Orders on their Bankers may exchange them for Orders at the new rate. Meanwhile, members wishing to make payments in advance are earnestly requested to note the alteration, and thus save much correspondence.

THE CHEMICAL INDUSTRIES AT THE MANCHESTER JUBILEE EXHIBITION OF 1887.

Manufacturers of chemicals, and all those in whose processes Chemistry plays a principal part, will be interested to know that in Section III. of this Exhibition it is intended that a system and method will be followed, both as to arrangement and style, such as has never been attempted before.

We understand that not only will the exhibits be arranged in suitable groups, classified according to their chemical nature, but that in these groups themselves a kind of natural order will be observed—a certain chemical consecutiveness—tending to enhance in a degree never before attained the instructiveness and usefulness of an examination and study, whether by the experienced manufacturer, or the student of Chemical Technology.

It will, we understand, be the aim and endeavour of the Committee of Section III. of the Jubilee Exhibition in Manchester so to classify and arrange, and so to illustrate by means of raw material, specimen of product, model and diagram, that the visitor may be mentally transported into the factory and works; and that without the danger of learning *too much*, in the shape of trade and manufacturing secrets, he may be enabled to grasp the general methods of procedure and the outlines of those processes with their

chemical reactions, which, starting with the raw materials, at length furnish the finished products and wares, ready for the market. For such a display considerable space will be required, and the Executive Committee, fully aware of the fact, has wisely allotted a large share of space for the purpose, probably a larger area than ever before devoted in an exhibition to exhibits relating to Chemical Industry.

The justification for such a large scale illustration of the modern attainments, as well as the progress, of Applied Chemistry in an exhibition like the one fast hastening to its completion in Manchester, is not far to seek, for we may with truth say that of all the great industrial branches, those in which Applied Chemistry plays a principal part have almost entirely risen and developed during the VICTORIAN ERA.

This, we consider, is justification sufficient for the special stress which it is proposed to lay upon the exhibits relating to the rise and development of the Chemical Industries in the Manchester Jubilee Exhibition of 1887.

Intending exhibitors in Section III. will be able to obtain particulars of the classification to be adopted, and the names of the gentlemen forming the Committee, from the Sectional Programme already issued with the last number of this Journal, and which, with the general programme, giving names of Executive Committee, Plan of Exhibition, Notices to Exhibitors, etc., may be obtained at the offices of the Exhibition, Albert Square, Manchester. We understand the time during which applications for space can be received, is now to be extended to December 1st.

CHANGES OF ADDRESS.

R. L. Barnes, 1/o The Savoy; Phoenix Chemical Works, Hackney Wick, E.
C. W. Duckworth, 1/o North View; Garner's Buildings, North Road, Clayton, Manchester.
J. A. Graham, 1/o St. Leonards; Sherborne Lodge, Werter Road, Putney, S.W.
Jno. Gray, 1/o Loanhead; Clippens Oilworks, by Johnstone, N.B.
Thos. Harris, 1/o Old Quay; The Union Acid Co., Runcorn.
E. Hore, 1/o Hampstead; 88, King Henry's Road, Chalk Farm, N.W.
M. Ikuta, 1/o Freiburg; Universitäts Laboratorium, Erlangen, Bavaria.
T. H. Leeds, 1/o Stoke Newington; "Wearside," Forest Gate, E.
W. Jesse Lovett, 1/o Alverthorpe Road; Jessamine Cottage, Thornes, near Wakefield.
W. Cossar Mackenzie, 1/o Linlithgow; 2, Grove Terrace, Edinburgh.
Dr. E. von Salis Mayenfeld, 1/o Clayton; Verein Chemischen Fabriken, Waldhof bei Mannheim, Germany.
Dr. Hugh R. Mill, 1/o Granton; 3 Glenorchy Terrace, Edinburgh.
L. Percival, 1/o Carlyle Road; 15, Reservoir Road, Edgbaston, Birmingham.
J. Pettigrew, 1/o Greenock; Varnish Manufactory, Carpenter's Road, Stratford, E.
J. M. Roberts, 1/o Manchester; 16, St. Paul's Street, Southport.
Thos. Royle, 1/o Silvertown; The Cedars, West Ham Park, E.
Jas. Russell, 1/o Carlisle; Coats Steel Works, Coatbridge, N.B.
T. Shimidzu, 1/o College of Engineering; c/o T. Hirano, H. Ginza Shichome, Tokyo, Japan.
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R. Tervet, 1/o Johnstone; Forth House, Fisherrow, Musselburgh, N.B.
Leonard T. Thorne, 1/o London; University College of Wales, Aberystwith.
A. Waché, 1/o Paris; Sucrerie de Crépy en Laonnois, Aisne, France.
J. C. Watson, 1/o Church; The Rhyddings, Oswaldtwistle, near Accrington.

CHANGES OF ADDRESS REQUIRED.

C. S. Gorman, 1/o Eglinton Chemical Works, Irvine, N.B.
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Deaths.

J. Spear Parker, 297, Western Bank, Sheffield, Oct. 8.
Wm. Southall, Sir Harry's Road, Edgbaston, Birmingham.

LIST OF MEMBERS ELECTED, 29th OCTOBER, 1886.

Arthur J. Banks, 229, Wavertree Road, Liverpool, chemist, butterine works.
Clayton Beadle, Beadonwell, Belvidere, Kent, papermaker.
Edw. M. Bruce, Omaha, Nebraska, U.S.A., chemist, Union Pacific R.R.
E. E. Burnett, 118, Huddleston Road, Tufnell Park, N., scientific chemist.
Hamilton Y. Castner, 218, West 20th Street, New York, U.S.A., and 23, Cecil Street, Strand, W.C., chemist.
Jno. H. J. Dagger, 3, West Bank Road, Edge Lane, Liverpool, analyst-assayer.
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W. H. H. Harland, 111, Hyde Park Street, Glasgow, sanitary engineer.
Arthur Hartley, Cannon Brewery, Brighton, brewer.
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Wm. Mackinlay, Laboratory, Silicate Paint Works, Charlton, Kent, chemist.
Robt. Oxland, 32, Portland Square, Plymouth, public analyst.
Francis R. Palmer, Debdon Hall, Loughton, Essex, printing ink manufacturer.
W. Grant Paton, Greenbank Alkali Works Co. (Limited), St. Helens, manager.
Richard Smith, Metallurgical Laboratory, Royal School of Mines, South Kensington, S.W., metallurgist.
Arthur H. Tuer, 40, Rock Street, Bury, and 51, Arcade Chambers, St. Mary's Gate, Manchester, analyst.
J. Veitch-Wilson, Queen Street, Bradford, Manchester, oil manufacturer.
J. Millar Wilson, Box 42, Chester, Pa., U.S.A., chemist.

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W. Crowder.	T. Royle.
C. Graham.	John Spiller.
S. Hall.	G. C. Trewby.
A. K. Huntington.	J. Williams.

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SESSION 1886-87.

Prospective Arrangements.

Nov. 1.—Mr. Lewis T. Wright, C.E., "What shall we do with our Tar?"
Dec. 6.—Mr. E. H. Trachsel, "On Strontium Hydrate," Mr. T. Fairley, on "Various Forms of Filter Pumps and Water Jet Aspirators."
Jan. 3.—Mr. Watson Smith, "On the Explosive, 'Kinetite.'"
Feb. 8.—Mr. W. Jago, "On Fermentation in its relation to Bread Making."

Notices of Meetings and Papers will be found in the Scientific Journals.

Notices of papers and communications to be made to the Local Secretary.

Liverpool Section.

Chairman: Prof. J. Campbell Brown.

Vice-Chairman: Dr. F. Hurter.

Committee:

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J. W. Kynaston.	J. C. Gamble.
E. K. Muspratt.	D. Herman.
Jas. Simpson.	F. Hurter.
J. Atleek.	A. Norman Tate.
E. G. Ballard.	A. Watt.

Local Sec. and Treasurer: W. P. Thompson, 6, Lord Street, Liverpool.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

The next Meeting will be held at the University College, Ashton Street, on Wednesday evening, Nov. 3, 1886, when an Address by the Chairman will be delivered, after which Dr. G. Schack-Sommer will read a paper on "Sugar Refining."

Obituary.

WILLIAM RIPLEY NICHOLS,

Late Professor of Chemistry in the Massachusetts Institute of Technology, Member of the Society of Chemical Industry.

WILLIAM RIPLEY NICHOLS was born in Boston, April 30, 1847, and died at Hamburg, July 14, 1886. He graduated at the age of 16 years from Roxbury Latin School, and then went upon a travelling expedition to Europe for about two years, a considerable portion of which time was spent in Greece and Germany. In the latter country Mr. Nichols acquired an almost complete mastery of the German language, and in the former such a proficiency that he was able to give instruction for a time in the modern Greek tongue.

Entering Harvard College on his return to the States, he remained there a few months, and then removed his connection to that institution, from which "he was not separated till death, either in love or service." He appears to have been a born linguist, and to have given instruction in the languages with which his study abroad had made him familiar, and with great effect. It is stated that from the time his entrance fee at college was paid he had never looked beyond his own services for funds, so that he began to draw a salary very early after his matriculation as a student. In 1869 and 1870 he was instructor; from 1870 to 1872 assistant professor; from 1872 onward to the time of his death he occupied the Professor's chair in the Massachusetts Institute of Technology.

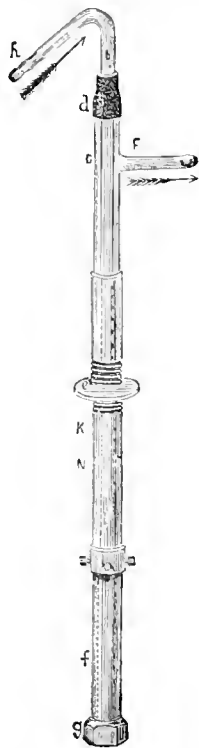
From the time he entered the institution till the spring of 1882 his important printed catalogued reports and treatises number 40, besides a multitude of minor articles and reports—more than one important book or careful scientific report for every year he had lived. He became eminent in the subject of chemical analysis, on which he worked and wrote considerably, and on the special subject of water analysis he is said to have been a standard, if not the most eminent, authority in the United States, and his counsel and opinion on the subjects of health-topics and water supply were sought by the representatives of most of the large cities and towns of New England. His hope this year had been to be present at the meetings of the British Association. He appears to have erred in over-taxing his strength, and thus injuring and destroying a strong constitution. He had literally strung his bow, and kept it strung day and night. Early in 1882, Professor Nichols published a catalogue of the writings of the graduates, students, and faculty of the Massachusetts Institute of Technology. The preface closes with these words, characteristic of the earnest and self-denying, self-forgetful man:—"The work will be kept in such shape that in case of accident to the present compiler someone else can readily take it up and carry it on."

Journal and Patent* Literature.

I—GENERAL PLANT, APPARATUS, AND MACHINERY.

A Heat-regulator in connection with the Thermostat.
R. Muencke. Chem. Zeit. 10, 998.

THE heat-regulator is based on the same principle as L. Meyer's, but has the advantage of being less breakable and more simply handled. A steel tube, of 25cm. length



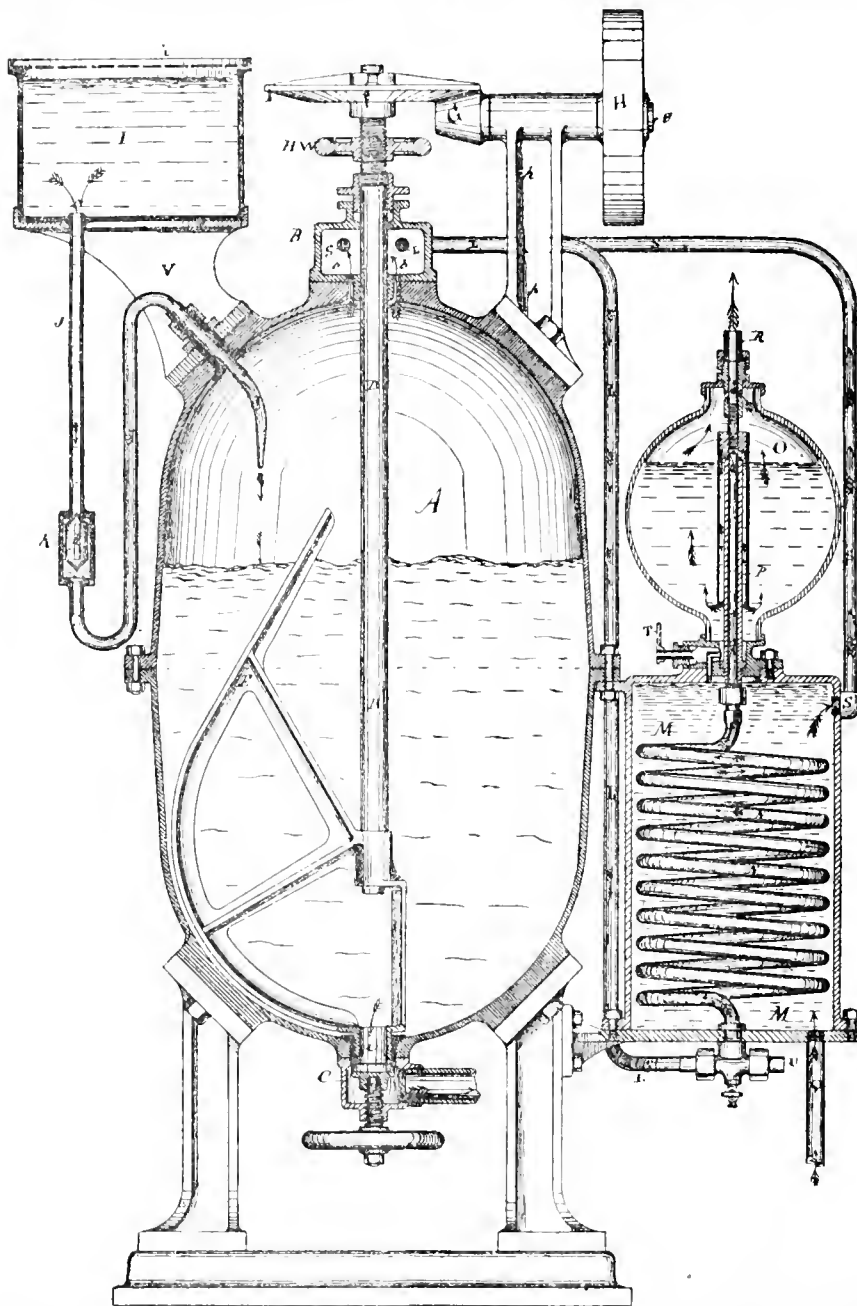
and 10mm. diameter, is provided at one end with a screw-cap *g*, and at the other with a thread and collar *c*. The cap closes the steel tube quicksilver-tight, the collar serving for adjusting the depth to which the regulator is put into the socket of the thermostat. 12cm. from the bottom are three small projections, which keep in its place a small cylindrical tube *f*, closed at the top. A glass tube *c*, with a branch *r*, is cemented into the steel tube, and the tube *b* conveying the gas to the apparatus is inserted into *c* by the india-rubber joint *d*. In order to use the regulator, the cap *g* is unscrewed, and after filling the glass tube *f* almost completely with quicksilver, the remaining space is filled with some drops of that liquid, with the vapour of which the regulator is intended to work. The tube *f* is then closed with the thumb, turned upside down, and immersed in a basin with mercury. The steel tube is put over the glass tube *f*, and the cap screwed up under mercury. By loosening the joint *d*, the tube *b* is removed, and so much mercury poured into the steel tube as will make it visible in the tube *c*. The tube *b* and joint *d* are replaced, and *b* moved down until it nearly touches the quicksilver. The regulator is now ready to be adjusted for the special purpose required. It is put in water and warmed to the degree

* Any of these specifications may be obtained by post, by remitting the cost price, plus postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8d.,	4d.
Above 8d., and not exceeding 1s. 6d.,	1d.
" 1s. 6d., "	2s. 4d.,
" 2s. 4d., "	2s. 4d.,
" 2s. 4d., "	2d.

of temperature which is not to be exceeded. The vapours in *f* force the mercury from *f* into *c*, closing up the opening of *b*. The latter must therefore be raised so that it is just closed by mercury at the highest temperature which is admissible. It is then put into the thermostat. Prof. Fraenkel testifies to the accuracy

out, that it prevents the possibility of the admission of air to the apparatus, and reduces the temperature of the gas before leaving the apparatus. The main features are the generating vessel *A*, provided at the top with the stuffing-box *B*, having a chamber, *b*, in it, the acid vessel *I*, and the cooling and washing arrange-



of the apparatus; the temperature never varies more than 0.1°C ., provided the barometric pressure remains constant.—S. II.

Improvements in and relating to Apparatus for Generating Carbonic-acid Gas. F. G. Riley, London. Eng. Pat. 11,219, Sept. 21, 1885. 8d.

THE advantages claimed for the apparatus are, that it can be made of enamelled iron, that it automatically controls the supply of acid and obviates the risk of its blowing

out, that it prevents the possibility of the admission of air to the apparatus, and reduces the temperature of the gas before leaving the apparatus. The main features are the generating vessel *A*, provided at the top with the stuffing-box *B*, having a chamber, *b*, in it, the acid vessel *I*, and the cooling and washing arrange-

ment *M* and *O*. The generator *A* is furnished with a mechanical agitator driven by friction gearing. The acid vessel *I* is connected to *A* by the pipe *J*; this has interposed in it the valve chamber *K*, which has a seating both on its upper and lower orifices for the floating valve *V*, which, when the vessel *I* is full of acid, covers the upper orifice, but allows the acid to pass into the main vessel *A* till sufficient gas is generated to close the valve and shut off the supply of acid. When the pressure of gas is reduced by the withdrawal of some gas, it opens and allows acid to pass. This operation continues till

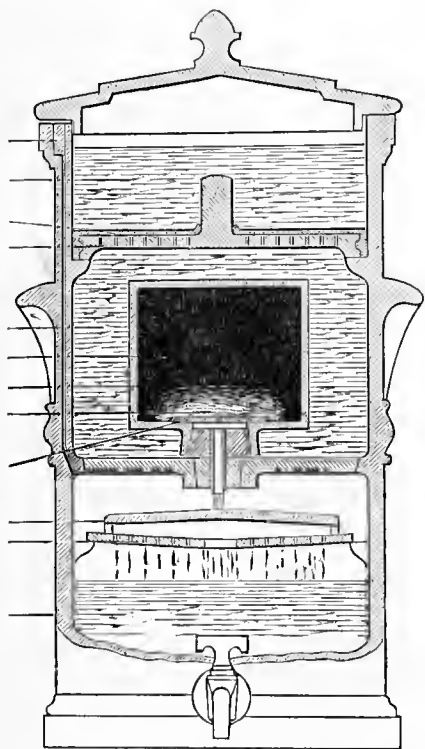
the acid is exhausted, when the valve K floats with the last portion of the acid and covers the bottom orifice, thus preventing the entrance of air into the apparatus. The gas passes into the chamber *b*, and thence through the coil N, which is externally cooled, into the bottom of the purifier O, which may be made of glass, and is partially filled with water. The gas ascends and descends the double tube P, bubbles through the water, and is drawn off at R. If it be desired to work the apparatus continuously, a duplicate generator, A, is provided, and connecting it to the cooler and purifier at U, it enables the generating vessels to be alternately charged.—S. H.

Improvements in Filter-presses. A. F. Vuytsteke, Belgium. Eng. Pat. 12,773, Oct. 24, 1885. 8d.

THIS invention relates to sundry improvements in the details of filtering presses, such as the fastening of the filtering cloths, means for easy removal of the imprisoned air, a method of clearing the passages, and the quick opening and closing of the press, for detailed description of which the specification should be consulted.—B.

Improvements in Filters. E. C. Allam, London. Eng. Pat. 9838, July 30, 1886. 6d.

THE inventor claims the use of a mechanical separator, composed of asbestos and porous earthenware or stone, in combination with a chemical purifier consisting of carbon, oxide of manganese, magnetic oxide of iron and lime, and with one or more shelves for spreading out the



filtered water in contact with filtered air as aëerator, substantially as shown in the arrangement of a domestic filter, represented by the accompanying sketch.

1. Unfiltered water.
2. Layer of asbestos cloth.
3. Perforated shelf for supporting the cloth.
4. Partially filtered water.
5. Vessel of porous stone or earthenware, held in position upon a solid plate by means of a stopper provided with a passage-tube.

6. The chemical ingredients mentioned above secured in the vessel, either separate or mixed together.
7. A layer of asbestos.
8. A layer of asbestos cloth.
9. Space for filtered air.
10. Spreader for the filtered water.
11. Perforated plate or shelf.
12. Chamber for filtered and aërated water.
13. Passage for air, closed with a plug of filtering wool.

—B.

Improvements in Apparatus for Evaporating Sea-water, Nitrate, or other Solutions of Liquids. F. B. Doering, Liverpool. Eng. Pat. 10,657, Sept. 9, 1885. 8d.

THIS invention has reference to evaporating apparatus in which a solution contained in tubes is heated by the action of steam surrounding the tubes, part of the steam given off by the liquid on evaporation being used again for aiding the heating of the remaining liquid. This is accomplished by the application of an injector, which withdraws the steam from the top of the pan and returns it to the space around the tubes. The description of one modification of the apparatus will make the arrangement clear without a sketch.

An upright cylindrical evaporating pan is divided into three sections by two horizontal diaphragms, which act also as tube-plates to a number of small upright tubes connecting the upper with the lower space. The part shut off by the two tube-plates is supplied with steam which surrounds and heats the tubes, and forms a "steam drum." The liquid to be evaporated is put into the pan, and fills it beyond the height of the steam drum, leaving sufficient space above for evaporation. To the top of the pan is attached an ejector, which withdraws the vapour arising from the liquid and discharges it, together with the live steam from the boiler, into the steam drum. There are contrivances for separating the liberated air from the vapour or steam, for removing condensed water, for promoting circulation in the liquid, for collecting crystals or sediment, and for other contingencies or requirements.—B.

II.—FUEL, GAS, AND LIGHT.

On the manner in which Sulphur in Coal and Cokes is combined, and on the Production of Cokes poor in Sulphur. Dr. F. Muck. Stahl u. Eisen, 1886, 6, 468.

THE author contradicts the widespread assumption that the amount of sulphur contained in coal is chiefly due to pyrites, and points out that almost all classes of coal contain what he calls "organic" sulphur, the presence of which it will hardly be possible to prove directly. But it cannot be doubted in all those cases where the iron contained in a specimen of coal does not suffice to bind all the sulphur present for forming FeS_2 . There can hardly be a question of sulphur being lost by burning in the furnace, for during the chief period of "de-gasification" an actual combustion is not going on; also a diminution in the quantity of sulphur would necessitate a much larger waste in coke than it is possible to assume under normal conditions, or than actually takes place. Nor is a great loss in sulphur possible when the cokes are quenched, as the mass cools down rather quickly, and the water only penetrates to a small depth. Coals that are poorest in sulphur do not of necessity furnish cokes equally poor in sulphur. The iron compounds (carbonate, oxide, and silicate) contained in coals are reduced in the coke-oven to iron, just as in the blasting-furnace, and this iron binds the sulphur which is expelled simultaneously or later, forming ferrous sulphide probably. Lime and magnesia compounds have a similar effect as the iron compounds. Carbon bisulphide, which is undoubtedly, if only temporarily, formed in the coke-oven, is acted on by iron, and also by ignited oxides of the alkaline earths, with production of sulphides. The quantity of sulphur emitted from the pyrites, or the quantity of "organic" sulphur which escapes with the coking gases, or which remains with the cokes as sulphides, is consequently not so much

dependent upon the total amount of sulphur contained in the coal as upon the nature of the mineral ingredients. In order to get an idea of the amount of sulphur really contained in a specimen of coke, the only method is to convert a certain quantity of the particular coal into coke, by igniting in a platinum crucible, etc., and then examining the cokes obtained. To produce coke poor in sulphur, the coal should not only be selected with reference to the size of the grains, but also—though this is much more difficult—by having regard to the quality. One can never expect to obtain from coal poor in sulphur coke also containing a small percentage of sulphur, if the ash of the coal is found rich in lime and magnesia, and particularly so if large quantities of iron are present.—A. R.

Manufacture of an Illuminant Appliance for Gas and other Burners. C. A. von Welsbach, Vienna. Eng. Pat. 15,286, March 15, 1886. 6d.

THIS invention consists in the application of a cap or hood to gas or other burners, to increase their illuminating power. The cap is made of cotton or other suitable material, impregnated with the oxides of lanthanum and zirconium, or of these with yttria. Proportions recommended are 60 per cent. zirconia, 20 per cent. yttria, and 20 per cent. oxide of lanthanum. The fabric is strengthened and supported with fine platinum wire, and suspended in the flame. On igniting in the flame the fabric is quickly reduced to ash, the cotton being burnt away and the earthy matter still retaining the form of a cap or hood.—A. R. D.

Improvements in the Generation of Gas for Lighting and Heating Purposes, and the necessary Apparatus therefor. B. Andreol, Vienna. Eng. Pat. 9720, May 7, 1886. 8d.

THE generator is supplied with fuel from above, through a hopper shaped like an inverted cone. Round this hopper are channels, through which the generated gases pass, so that the fuel is already heated when it reaches the generator. It is recommended that two generators be worked together. To one an air blast only is supplied, while in the other steam takes the place of air. The two kinds of gas thus formed may be mixed or used separately. For further particulars the drawings accompanying the specification must be consulted.—A. R. D.

Improved Construction and Arrangement of Apparatus for conducting Gas-flame Heat to Hydrocarbon containing Vessels for Increasing the Brilliancy or Lighting Power of Coal Gas. H. E. A. Wallis, London. Eng. Pat. 10,778, June 10, 1886. 8d.

THIS invention consists in arranging a solid conductor so that one end of it absorbs the waste heat of a gas flame, while the other end communicates with a vessel containing a hydrocarbon (preferably solid), such as naphthalene. The heat-absorbing end of the conductor is conical or cup-shaped, and is placed above the flame. The heat thus absorbed is communicated by conduction to the hydrocarbon, which is thereby vapourised and rendered available for enriching the gas used.—A. R. D.

Improvements in Apparatus for Manufacturing Illuminating Gas from Volatile Liquid Hydrocarbons. H. Howell, Wrexham. Eng. Pat. 11,713, June 17, 1886. 11d.

THIS invention relates to improvements upon the apparatus described in Eng. Pat. 3863, of 1872. The illuminating gas is made by allowing liquid hydrocarbon to trickle down a series of towers, wherein it meets an ascending current of air. The towers are fitted with perforated zinc shelves, and the spaces between these are filled loosely with curled horsehair. The current of air is forced through the apparatus by any suitable mechanical means.—A. R. D.

Improvements in Apparatus for Carburetting Air to be employed in lieu of Coal Gas for obtaining Light and Heat. J. Foord and W. W. Paddon, London. Eng. Pat. 11,664, June 28, 1886. 8d.

THE current of air set in motion by a ventilating shaft is made to work a fly similar to a smoke jack. This puts in motion a horizontal axis, the ends of which project into two carburetting vessels, and are provided with agitators. A portion of the air current is intercepted at the entrance to the shaft, and led through these carburetting vessels. Here it is impregnated with the vapours of the contained hydrocarbon liquid, and converted into a gas available for lighting and heating purposes.

—A. R. D.

Improvements in the Manufacture of Illuminating Gas and Volatile Liquid Hydrocarbons. J. L. Balfour and J. Lane, Tamworth. Eng. Pat. 12,721, July 12, 1886. 6d.

THIS invention consists in adding from 5 to 10 per cent. of pitch (preferably the kind known as soft coal-tar pitch) to the coal used in the manufacture of illuminating gas. The distillation is conducted in other respects in the usual manner. The chief advantages claimed are an increased yield and illuminating power for the gas, with a greater richness in benzene, while the coke is denser and more free from sulphur.—A. R. D.

Invention for the Purification of Gas in its Passage direct from the Meter previously to entering the Service Pipes for Household Consumption. H. Harris, London. Eng. Pat. 12,638, July 19, 1886. 6d.

A BOX filled with granulated animal carbon, thoroughly cleansed with a solution of soda, is so placed that the gas leaving the meter must pass through it before it reaches the point of consumption. The advantages claimed are the checking and purifying of the gas, and a great saving in the quantity used to produce a given effect.—A. R. D.

Improvements in Apparatus for Manufacturing Gas from Oil. E. Mansfield, Manchester. Eng. Pat. 6647, July 21, 1886. 8d.

THIS invention relates to improvements in the apparatus known as "Mansfield's Oil Gas Apparatus." The annular space surrounding the retort is divided into two by a partition extending from the bottom to the top. The object of this is to keep the heated products of combustion longer in contact with the retort, as they now have to pass up on one side thereof, and downwards on the other. The feed pipe supplying the oil is passed through the "bonnet" of the retort itself, instead of through the casing, and reaches nearly to the bottom of the retort, so that the oil is already hot when it drops upon the heated metal.—A. R. D.

Method of obtaining Compounds of the Rarer Metals from their Earths, for use as Incandescence Bodies for Illuminating Purposes. Carl Auer von Welsbach, Vienna. Eng. Pat. 9806, July 29, 1886. 6d.

THIS patent has reference to Patents 15,286 of 1885, and 3592 of 1886, relating to the preparation of solutions for the production of "incandescence" bodies. The patent essentially is a process of the chemical treatment of cerite, orthite, and similar minerals containing cerium, didymium, lanthanum, and zirconium, with a view to their separation in a state of purity, not only from each other, but especially from iron, which is found to exert a most detrimental action on the "incandescence" of these bodies.—T.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

A New or Improved Substitute for Turpentine. S. Banner, Liverpool. Eng. Pat. 12,249, Oct. 14, 1885. 6d.

THIS product is essentially prepared by selecting, during the distillation of petroleum, coal oil, and other similar

heavy hydrocarbons, groups of fractions containing hydrocarbons of specific gravity, varying from 0.730 to 0.840. These fractions are suitably mixed or blended together.

—E. G. C.

Process for the Production of Resin-acid Esters (Ethers) applicable as Substitutes for the Resins or Gums usually employed in the Manufacture of Varnishes and Lacquers.* Dr. E. Schaal, Württemberg. Eng. Pat. 9027, July 10, 1886. 6d.

THE resin-acid esters (ethers) are prepared by first condensing the resin acids to esters by treatment with alcohols, phenols, and hydrocarbons, under heating, with or without pressure, and with or without the addition of substances that facilitate the reaction, and then separating the product by distillation into soft and hard resinous bodies. For the manufacture of varnishes or lacquers, the resin-acid esters are combined with volatile or fatty oils, hydrocarbons or alcohols.—E. G. C.

IV.—COLOURING MATTERS AND DYES.

Improvements in the Production of Colouring Matters. Wm. Clark, London. From the "Farbfabrik vorm. Bröner," of Frankfurt-on-the-Main, Germany. Eng. Pat. 10,377, Sept. 1, 1885. 4d.

THE colouring matters described are azo-compounds, obtained by diazotising paranitraniline, and combining the paranitrodiazobenzene chloride with the β -naphthylamine-sulphonic acids obtained by the action of ammonia upon the salts of the β -naphthol-sulphonic acids, according to the Patent 3724 of 1882. Thus, by acting with diazotised paranitraniline upon β -naphthylamine-mono-sulphonic acid (sodium salt) in an alkaline or acetic acid solution, a colour is formed which dyes like archil.

—R. M.

Improved Method of Treating Antimonial Ores or Compounds for the Production of Pigment. T. C. Huntington and Marco Chiapponi, Italy. Eng. Pat. 12,723, Oct. 23, 1885. 6d.

THE finely-divided ores or compounds are treated with an aqueous solution of barium sulphide, heat being applied if desired. The solution is run off into a second receptacle, for treatment with a current of air and carbonic acid. This combined current first precipitates the barium in the form of carbonate, and afterwards the whole of the antimony as "hyposulphite." The former precipitate is separated by decantation or otherwise, and the latter, after filtering and drying, is ready for use as a pigment.—E. G. C.

Improvements in the Manufacture of Colouring Matters. H. H. Lake, London. From Messrs. Wirth & Co., of Frankfurt-on-the-Main, agents for Messrs. A. Leonhardt & Co., of Muhlheim a/Esse, Germany. Eng. Pat. 14,962, Dec. 5, 1885. 4d.

THE colouring matters described in this specification are nitro-chrysoïdines obtained by the action of diazotised nitranilines, and their homologues, upon metaphenylene diamine and its homologues. The compound produced from metanitraniline is said to dye wool, cotton, and silk, of a similar shade to chrysaniline. Paranitraniline gives a browner yellow, and orthonitraniline a brown-red. Sulphonic acids are obtained by using the sulphonic acids of the nitranilines, and carboxylic acids by combining nitroamidobenzoic acids with the diamines. The inventors call these colours "azophosphines."—J. M.

* The word "ester" is a convenient term adopted in Germany to signify that class of ethers which is formed by replacing hydrogen in the hydroxyl of mineral and other acids by alcohol radicles.

Improvements in the Manufacture and Application of Blue Colouring Matters for Laundry Purposes. R. Barringer, J. H. Wallis, and W. Barringer, Mansfield. Eng. Pat. 5938, May 1, 1886. 6d.

ANY suitable blue colour or dye is combined with a readily soluble adhesive material, and applied to a convenient absorbent fabric—such as paper, for instance. The material so prepared is put up in rolls, or cut into leaves or sheets, of any required size or shape. These are made up in envelopes, books, or other convenient form, for the market.—E. G. C.

Improvements in the Manufacture of Ultramarine, and in Furnaces and Apparatus to be used therein. L. J. B. Bouillet, London. Eng. Pat. 9176, July 14, 1886. 8d.

THE colour-producing materials are formed into brick-like packets or masses of uniform dimensions, contained in envelopes of paper highly charged with mineral matter, and arranged in mufles within a furnace having a floor of fire tiles laid over flues, passing transversely beneath the mufles. The mufles are provided with hollow sides, within which the heat can circulate, and with arched roofs abutting upon them. The ceiling of the furnace consists of fire tiles, supported upon bars of iron, easily removable to give access to the mufles.

—E. G. C.

Process for the Production of a Bluish-black Colour. Ludwig Schäd, Berlin. Eng. Pat. 9754, July 28, 1886. 4d.

THIS colouring matter is a secondary azo-compound produced by the action of diazo-azobenzene-disulphonic acid upon paratolyl- β -naphthylamine. The latter substance is dissolved in alcohol and hydrochloric acid, and then the diazo-azobenzene-disulphonic acid added. The free acid of the colouring matter separates out on the addition of salt, and is purified by solution in alkali, filtration and salting out.—R. M.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

Improved Process for Removal of Gum from Grass and Plants. H. J. Haddan, London. From Louis Emile Vial, Marseilles. Eng. Pat. 10,936, Sept. 15, 1886. 6d.

THIS invention consists in the steeping of raw flax, China grass, and other textile vegetable matter, first in a bath of olein or other fatty acid "in a fluid or saponaceous state," until impregnated. The textile matter is next steeped in a bath of carbonate or caustic alkali solution, kept at a nearly boiling temperature, by which the pectose is transformed into alkaline pectate. The fibre is then steeped in a bath of pure water, or water slightly acidified, after which it only requires washing. Directions are given for the recovery of the fatty acids and pectic acid.—B. H.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

On Iron- and Chromium-Alizarates. L. Liechti and W. Suida. Mittheilungen des Tech.-Gew. Museums. 3 [1], March, 1886, 1—17.

A.—COMPOUNDS OF IRON AND ALIZARIN.

I. Ferrous Alizarate.

THIS substance is produced by the double decomposition of FeSO_4 and ammonium alizarate solutions, as a black violet precipitate. On washing with water, it is partially dissolved, and becomes more oxidised. It is noteworthy that even after long-continued exposure (four weeks) in the moist condition, the oxidation of the ferrous oxide in this compound ceases with the formation of the ferroso-ferric oxide, $(\text{Fe}_2\text{O}_3)(\text{FeO})$, so that the fully-oxidised compound corresponds to the normal alizarin-red previously described (see Journal, vol. iv. p. 587), in which ferric oxide is replaced by Al_2O_3 , and ferrous oxide by CaO .

Freshly-prepared moist ferro-alizarate dissolves readily in ammonia, and the solution mixes with Turkey-red oil without change. The alizarin prevents, therefore, the precipitation of ferrous hydrate by the ammonia.

The ferro-ferric alizarate forms, on drying, a black violet powder, possessing a bronze lustre.

II. Ferric-alizarate.

If solutions of ferric chloride and ammonium alizarate are mixed together according to the equation $\text{Fe}_2\text{Cl}_6 + 3\text{C}_{14}\text{H}_6\text{O}_4(\text{NH}_4)_2 = \text{Fe}_2(\text{C}_{14}\text{H}_6\text{O}_4)_3 + 6\text{NH}_4\text{Cl}$, a brownish-black precipitate of ferric-alizarate is thrown down; it is somewhat soluble in distilled water, and very soluble in ammonia, giving a violet-coloured solution, which mixes with Turkey-red oil without alteration. If the precipitate is well washed, dried, and extracted with ether, a moderately large amount of alizarin dissolves out, and the residue, on re-drying, forms a black powder which, on analysis, gives the formula $\text{Fe}_2\text{O}_3(\text{C}_{14}\text{H}_6\text{O}_4)_{2.25}$.

III. Action of Calcium Acetate on Ferric-alizarate.

Solutions of ferric chloride, containing definite proportions of calcium acetate, are poured into ammonium alizarate solutions, when a fine violet-black precipitate is produced, which is well washed with water, extracted with ether, and dried.

If the materials are employed in the following ratio, $\text{Fe}_2\text{Cl}_6 : 6\text{NH}_3 : 3\text{C}_{14}\text{H}_6\text{O}_4 : \text{Ca}(\text{C}_2\text{H}_3\text{O}_2)_2$, the precipitate is only partially soluble in ammonia, and the filtrate from it contains no lime. If larger proportions of calcium acetate are used (2 and 3 mols.) the same precipitate is produced, and the excess of lime is found in the filtrate. An analysis of the various precipitates showed their composition to correspond to the formula $(\text{Fe}_2\text{O}_3)\text{CaO}(\text{C}_{14}\text{H}_6\text{O}_4)_3\text{H}_2\text{O}$. It appears, therefore, that when excess of calcium acetate is used, the compound formed is always analogous in composition to that of normal alizarin-red.

IV. Action of Ferric Hydrate on Alizarin and Calcium Acetate.

Freshly-precipitated and washed ferrous and ferric hydrate may be partially dyed by alizarin, but only slowly. The dyeing, however, proceeds rapidly and most thoroughly as soon as calcium acetate is added to the mixture.

If pure ferric hydrate, freshly prepared and well washed, is stirred up with a quantity of alizarin paste and water, in proportions corresponding to the formula $(\text{Fe}_2\text{O}_3)3\text{C}_{14}\text{H}_6\text{O}_4$, and the mixture gradually heated to 100° , and then boiled 5 hours, the water lost by evaporation being replaced, a precipitate is produced which is soluble to some extent in distilled water, giving a violet solution. If this is washed, dried, and then extracted with ether, the ether dissolves out a large quantity of alizarin. The residue, redried and analysed, has the formula $(\text{Fe}_2\text{O}_3)_3(\text{C}_{14}\text{H}_6\text{O}_4)_2$. It is more than probable that by the long-continued boiling, a part of the ferric hydrate loses some of its hydroxyl groups as water, thus forming only a very basic compound, which may also be regarded as a mixture of a less basic compound with ferric oxide.

If another portion of ferric hydrate is mixed with alizarin and calcium acetate in the following ratio, $\text{Fe}_2\text{O}_3 : \text{CaO} : 3(\text{C}_{14}\text{H}_6\text{O}_4)$, and boiled for 5 hours in a similar manner, a deep violet coloured precipitate is produced, which may be purified by water and ether as before, the latter dissolving out some alizarin. The aqueous filtrate from this precipitate contains no trace of lime, and shows a distinct acid reaction. This lake gives, on analysis, figures corresponding to the formula $(\text{Fe}_2\text{O}_3)\text{CaO}(\text{C}_{14}\text{H}_6\text{O}_4)_2\cdot 8$, from which it is evident that the ratio of ferric oxide to lime is again that of the normal alizarin colour.

If a third experiment be made, using the materials in the ratio of $\text{Fe}_2\text{O}_3 : 2\text{CaO} : 3(\text{C}_{14}\text{H}_6\text{O}_4)$, a black violet lake is produced, the filtrate from which contains much lime. This lake, when purified and analysed, gives results corresponding to the formula $(\text{Fe}_2\text{O}_3)\text{CaO}(\text{C}_{14}\text{H}_6\text{O}_4)\text{H}_2\text{O}$.

This substance, therefore, appears to be the normal alizarin violet, of which the normal proportions are $(\text{Fe}_2\text{O}_3) : (\text{RO})$.

V. Dye Trials.

These trials were carried out to determine the behaviour of ferric hydrate towards alizarin and lime in the presence of the cotton fibre.

1. Cotton cloth was mordanted with a mixture of ferrous sulphate and sodium acetate solutions corresponding to the ratio $(\text{FeSO}_4 + 7\text{H}_2\text{O}) : (\text{NaC}_2\text{H}_3\text{O}_2 + 3\text{H}_2\text{O})$, otherwise expressed thus: $[\text{FeSO}_4 + \text{Fe}(\text{C}_2\text{H}_3\text{O}_2)_2]$.

The cloth was then aged two days, afterwards fixed in a bath of cold dilute ammonia, and finally thoroughly washed in distilled water. The iron oxide in the cloth was then estimated, and four pieces of the cloth were dyed with increasing amounts of calcium acetate, and sufficient alizarin to form the ferric-alizarate. The dyed fents were then boiled out with distilled water, and analysed to determine the ratio of the oxide of iron to the lime. It is as well to mention that the mordanted cloth, when dyed without calcium acetate, produces only a weak brownish violet colour, whilst when this salt was present in the dye-bath, a fine violet colour was given.

The analysis shows that each molecule of iron oxide on the fibre requires one molecule of lime, and that even if excess of calcium acetate is present, only the amount corresponding to this one molecule is taken up.

2. A piece of calico was padded with a colour composed of ferrous acetate, acetic acid, alizarin, starch, and increasing amounts of calcium acetate, then dried, aged, steamed, and finally boiled out in distilled water. The proportion of the substances used were: 1 mol. of iron oxide, 3 mols. of alizarin, and 0, 1, 2, and 3 mols. of calcium acetate. Again the colour without the lime-salt was poor and weak, and contained only a trace of lime, whilst those produced with the addition of calcium acetate were of a rich brownish-violet tone.

To find what effect the operation of soaping has on the ratio of iron oxide to lime, a portion of the dyed and boiled cloth was boiled for 1½ hours in an open vessel with soap solution, then well washed and finally boiled in distilled water. The samples, both soaped and unsoaped, were then analysed.

The results fully confirm those deduced from previous trials relative to the amount of lime taken up by the lake. They show, further, that in soaping, both ferric oxide and lime are removed, but always in the same relative proportions.

To sum up, these experiments with alizarin violet, with the exception of the greater insolubility of the ferric alizarate in water, and the greater resistance of the violet to soaping, all tend to confirm in a clearer manner the facts obtained in the study of alizarin-red; further the acceptance of the formula $(\text{Al}_2\text{O}_3)(\text{CaO})(\text{C}_{14}\text{H}_6\text{O}_4)_3\text{H}_2\text{O}$, for that compound, is fully justified by the formula $(\text{Fe}_2\text{O}_3)(\text{CaO})(\text{C}_{14}\text{H}_6\text{O}_4)_3\text{H}_2\text{O}$, here obtained for alizarin violet.

B.—CHROMIUM ALIZARIN COMPOUNDS.*

1. Normal Chromium Alizarate.

If a solution of chrome alum is mixed with a sodium or ammonium alizarate in the proportion necessary to form normal chromium alizarate, a precipitate is thrown down, consisting of a mixture of chromium hydrate and alizarin. This is almost completely soluble in excess of soda (especially on warming), forming a brownish-red solution; and if this is exactly neutralised with dilute H_2SO_4 , the solution becomes of a purple-red colour, but no precipitate is formed. This solution is treated with a quantity of common salt, when a purple-red precipitate is thrown down, which is separated, dried, and then treated with absolute alcohol. On evaporating the alcohol, a greenish bronze mass remains, which, on analysis, corresponds to the formula of an acid chromium alizarate, $\text{Cr}_2(\text{C}_{14}\text{H}_6\text{O}_4)_3 + 3(\text{C}_{14}\text{H}_6\text{O}_4)$. This substance

* Although incomplete, the experiments with chromium alizarin compounds are sufficiently interesting to warrant their publication.

dissolves readily in water, even when dried, and also in ammonia, and the ammoniacal solution mixes with Turkey-red oil without decomposition.

If a solution of alizarin in sodium oleate (in equivalent quantities) is treated with chrome alum solutions, there separates out a mixture of alizarin, and probably chromium oleate, which remains unaltered even on boiling. The solution described by Liechti and Schwitzer as containing $\text{Cr}_2(\text{C}_2\text{H}_3\text{O}_2)_6 + 3\text{Na}_2\text{CO}_3$, when boiled with alizarin, gives a brownish-red precipitate, whilst with the so-called one-third sulphate (from chrome alum and soda) reaction only takes place when sodium acetate is added.

A mixture of alizarin and calcium acetate, or calcium alizarate by itself, dyes chromium hydrate with difficulty, even after long boiling; on the addition of sodium acetate, however, action at once commences.

Basic chromium alizarate cannot be obtained from chrome alum, alizarin and carbonate of soda mixed in the proportions expressed by the formula $(\text{Cr}_2[\text{SO}_4] + \text{K}_2\text{SO}_4 + 24\text{H}_2\text{O}) + 1.5\text{C}_{14}\text{H}_9\text{O}_4 + 3\text{Na}_2\text{CO}_3$, since the alizarin at once separates out, and in this case even the addition of calcium acetate is ineffectual.

Normal chromium alizarate can be prepared by treating a calculated amount of chromium-nitro acetate with a proportional amount of alizarin and an excess of ammonia, and then boiling the resulting reddish-violet solution till it is quite neutral. A purple-violet precipitate separates out, whilst the supernatant liquid becomes colourless. The precipitate is filtered off, washed with water, extracted with ether, and dried, and on analysis gives the formula $\text{Cr}_2(\text{C}_{14}\text{H}_9\text{O}_4)_3$.

This normal chromium alizarate is insoluble in water, but readily soluble in ammonia, giving a violet-red solution, which mixes without change with Turkey-red oil.

II. Chromium Calcium Alizarate.

This compound can be made in the same way as the normal chromium alizarate. A solution of chromium-nitro-acetate and calcium acetate is mixed with a solution of ammonium alizarate in excess of ammonia, when a blackish-violet precipitate of calcium alizarate is thrown down. The whole is then boiled till the excess of ammonia is driven off, when the precipitate becomes reddish-brown in colour, and the liquid colourless. If the ratio of the components is 1mol. chromium oxide, 1mol. CaO , and 3mols. alizarin, the filtrate, after boiling with ammonia, contains only a trace of lime. If a larger proportion of CaO , however, is used, this filtrate contains CaO in considerable quantity, but the precipitate remains of constant composition, corresponding to the formula $(\text{Cr}_2\text{O}_3)(\text{CaO})(\text{C}_{14}\text{H}_9\text{O}_4)_3$. It is insoluble in water, and soluble in ammonia, on boiling, with difficulty. The more lime there is used in the preparation, the more the precipitate assumes a black-violet colour.

III. Dye Trials.

These trials with chromium mordants correspond to those already mentioned with iron mordants. Cotton cloth was mordanted in a solution of chromium acetate, dried, fixed in a boiling soda solution, and finally well washed in distilled water. The amount of chromium oxide thus fixed on the cloth was then estimated by calcination. Four pieces of the mordanted cloth were then dyed with alizarin alone, and also with the addition of 1, 2, and 3mols. calcium acetate (reckoned according to the amount of chromium oxide found on the cloth). After dyeing, the fents were again boiled out repeatedly with distilled water, dried, and finally analysed, in order to determine the ratio of chromium oxide to lime. Without lime, only a poor, weak chocolate colour is obtained, while in those pieces dyed with 3mols. of alizarin and 1, 2, and 3 mols. of calcium acetate, it becomes darker with the increasing amounts of lime.

The analyses of the fents show that the normal ratio of lime is only attained in the third case.

Cotton cloth was also padded with a series of colours composed of chromium acetate, alizarin paste, and starch, with and without the addition of calcium acetate. The proportions being equivalent to 1mol. Cr_2O_3 , 3mols.

of alizarin, and 0, 0.5, 1, and 2mols. CaO . The cloth was afterwards dried, steamed, and finally boiled with distilled water. Part of each fent was then analysed, and the remainder soaped 1½ hours at the boil in an open vessel, washed thoroughly, and also analysed. Again the colour without lime was weak and worthless, and it became considerably paler on soaping, whilst where lime was present, a dark chocolate colour was produced (the colours being considerably stronger where 1 and 2mols. CaO were present than the others).

The above results show that like the aluminium and iron compounds of alizarin already mentioned (see this Journal, vol. ii. p. 537), the chromium compounds also tend to contain chromium oxide and lime in the ratio $\text{Cr}_2\text{O}_3 : \text{CaO}$, which ratio, however, is more altered during the operation of soaping than is the case with the iron compounds.

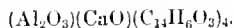
SUPPLEMENTARY NOTES ON CALCIUM AND ALUMINIUM ALIZARATES.*

I. Action of Calcium Hydrate on Normal Calcium Alizarate.

If normal calcium alizarate is mixed with perfectly clear lime-water in a closed vessel, and allowed to stand for some time, a portion of the calcium alizarate dissolves, forming a ruby-red solution. If this solution is then boiled for only a short time, a brownish-red precipitate separates out, whilst the supernatant liquid becomes quite colourless, and contains much free lime. This precipitate is soluble on continued washing with water, forming a violet solution. On analysis, it proves to be a basic calcium alizarate, having the formula $(\text{CaO}.\text{C}_{14}\text{H}_9\text{O}_4 + \text{CaO})$.

This is the compound originally dissolved in the lime-water, the behaviour of which solution, on warming, points to the existence of a much more basic calcium alizarate in the cold solution. Experiment shows, indeed, that about 5mols. CaO can hold in solution 1mol. of the basic calcium alizarate.

II. Aluminium Calcium Alizarate,



—This compound is readily produced as a fine dark-red precipitate by the action of calcium acetate and aluminium acetate on ammonium alizarate.

This lake is soluble on continued washing with water, and is also partially soluble in ammonia. The ammoniacal solution, when filtered and evaporated to dryness, leaves a residue which, according to analysis, possesses the formula $(\text{Al}_2\text{O}_3)(\text{C}_{14}\text{H}_9\text{O}_4)_4$, while the portion insoluble in ammonia is found to have the formula $(\text{Al}_2\text{O}_3)(\text{CaO})(\text{C}_{14}\text{H}_9\text{O}_4)_3$, the original lake having the formula $(\text{Al}_2\text{O}_3)(\text{CaO})(\text{C}_{14}\text{H}_9\text{O}_4)_4$. It appears, therefore, that ammonia dissolves out alizarin and normal aluminium alizarate, leaving behind an aluminium calcium alizarate, which is more basic than the normal alizarin-red.

III. Trials on Cloth.

Two colours made up with starch, aluminium acetate, calcium acetate and alizarin, and corresponding in their composition to the normal red and the normal red + 1mol. of alizarin respectively, were padded on the cloth, which was then dried, steamed, and finally well boiled in distilled water. A part was then analysed at once, whilst another part was soaped for 1½ hours at the boil in an open vessel, well washed in distilled water, and analysed. Both fents assumed a fine red colour on steaming. The cloth containing the extra amount of alizarin, however, showed spots of free alizarin on its surface, and alizarin was also removed when it was washed with hot water. After soaping, both samples were very similar in shade.

These experiments show that normal alizarin-red $[\text{Al}_2\text{O}_3.\text{CaO}(\text{C}_{14}\text{H}_9\text{O}_4)_3]$ is able to take up alizarin, but that the excess is removed by alkaline liquids. This can be

* See this Journal, vol. iv. p. 587.

readily shown by taking a piece of cloth dyed with the normal alizarin-red, steamed, and either soaped or left unsoaped, and dyeing it again in alizarin, when a further quantity of alizarin is taken up, which, however, is again abstracted on re-soaping.—J. F. C. S.

Studies in Mordanting Wool. L. Liechti and H. Schwitzer. Mittheilungen des Tech. Gew.-Museums, 41—109, Aug. 1886.

IN continuation of the work of Liechti and Suida relative to the behaviour of aluminium, iron, and chromium mordants towards cotton (this Journal, ii. p. 537) the authors have studied their action towards the woollen fibre. The behaviour of tin mordants was also examined. Woollen cloth was boiled with various solutions of mordants, and afterwards dyed with suitable colouring matters—e.g., alizarin, nitro-alizarin, alizarin blue S., cerulein S., gallein, old fustic, quercitron bark, weld, and cochineal. The natural colouring matters were specially selected for studying the action of the tin mordants. The behaviour of the mordants—i.e., the condition and amount of mordant fixed on the fibre—was determined by an examination of the dyed patterns. The water used being magnesian and calcareous, was previously neutralised with hydrochloric acid in the mordanting bath and with acetic acid in the dye-bath. Each sample was mordanted or dyed in thirty times its weight of water. In the mordanting operation the wool was put into the solution at 30–40° C., and the temperature raised to 100° C. in the course of half-an-hour, the boiling being continued for half-an-hour. Before dyeing the mordanted patterns were well washed. The mode of dyeing was similar to that of mordanting, but it varied somewhat according to the requirements of each colouring matter, the best method being selected for each. The amounts of mordant and colouring matter used were expressed in terms of percentage of the weight of wool operated upon. In the course of the experiments it was proved that the dyer's practice of allowing the mordanted or dyed wool to remain in the respective baths till cold possesses no advantages. Wool is only able to decompose and fix mordants in hot solutions, and the increased intensity of colour frequently produced by the practice referred to is of an illusory character, since it is merely owing to a superficial precipitation of colouring matter which is readily removed by hot water. The dyed patterns were not submitted to the operation of "fulling" or "milling."

I. Aluminium Mordants.—Wool was mordanted with equivalent amounts of aluminium sulphate, oxalate, and tartrate, corresponding to 1–10 per cent. of the first-named salt.

Wool mordanted with *aluminium sulphate* and boiled repeatedly with distilled water, always yielded an acid solution; when dyed with alizarin all the colours were dull-reds.

Wool mordanted with *aluminium oxalate* gave better reds, while those with which *tartrate* had been used gave still fuller and brighter colours. In each case the dye-bath solutions had an acid reaction. It was evident, from an examination of the spent mordant and dye-liquors, that the mordanting was most perfect in the case of the tartrate, the whole of the alumina being evidently fixed upon the fibre in a permanent manner. Subsequent experiment showed that aluminium tartrate may, without any disadvantage, be replaced by a mixture of 1 mol. aluminium sulphate, and 3 mols. cream of tartar. A suitable amount of mordant to use is 6 per cent. aluminium sulphate, or its equivalent. Suitable amounts of colouring matter to use are as follows: 5 per cent. alizarin blue S., 5 per cent. cerulein S., and 15–20 per cent. gallein (10 per cent. paste), 10 per cent. alizarin (yellow shade), 20 per cent. paste.

Similar conclusions relative to the above-mentioned mordants were arrived at with each colouring matter.

Experiments made with a view of determining whether a less proportion of cream of tartar than 3 mols. per 1 mol. aluminium sulphate could be used, showed that it could be reduced to 1½ mols. without serious detriment to the colours produced. Since the employment of

Seignette salt as an assistant was proved to be less advantageous than that of cream of tartar, in which case the mordanting bath contains, in addition to aluminium tartrate, a certain proportion of acid potassium sulphate, and since the general practical experience of dyers is that wool is better mordanted in an acid-bath, it was thought possible, perchance, to replace the cream of tartar by an acid—e.g., sulphuric acid. Experiment showed, however, that although a small addition (1 mol.) of sulphuric acid slightly increases the amount of alumina absorbed by the fibre, it cannot replace the cream of tartar; since, further, the addition of a larger amount (3 mols.), although it hinders the dissociation of the mordant solution, yields very unsatisfactory colours, it is evident that the beneficial action of cream of tartar cannot be ascribed merely to its retarding the dissociation of the mordant.

On submitting wool mordanted in a solution of aluminium tartrate to the repeated action of boiling water, it was found that the mordant was extremely well fixed, the further liberation of a small quantity of acid being the only essential result.

Boiling with water, after mordanting, would, therefore, be beneficial in all cases where the presence of acid in the dye-bath is objectionable, and in any case mordanted wool ought always to be thoroughly washed previous to dyeing.

Since it has already been shown by Liechti and Suida that the presence of potassium or sodium sulphate retarded the dissociation of certain aluminium and chromium salts used as mordants for cotton, it was thought possible that the presence of these salts in a mordanting bath of aluminium sulphate might retard the dissociation of the aluminium sulphate outside the fibre, to which action, in part at least, the beneficial employment of tartaric acid as an assistant is in some measure due. An experiment made with aluminium sulphate as a mordant, with and without the addition of sodium and potassium sulphate, showed that alum is no better—in fact, slightly worse—as a mordant, than aluminium sulphate, and does not support, therefore, the persistent preference which dyers have for alum.

An experiment was made with a view of determining whether the tartaric acid used along with aluminium salts played the rôle of a carrier, so that it might be possible to use any free acid along with only a small quantity of tartaric acid. The result obtained, however, proved that the tartaric acid plays no such intermediary part in mordanting wool with aluminium salts; on the contrary, a considerable amount of tartaric acid must be present (at least half the theoretical amount necessary to form aluminium tartrate) in order to fix on the wool sufficient alumina to yield full bright colours.

II. Tin Mordants.—Wool was mordanted with stannic and stannous tartrate, prepared by precipitating the respective chlorides with sodium carbonate, and dissolving the washed stannic hydrate in the calculated quantity of tartaric acid. Stannous hydrate being, however, little soluble in tartaric acid, was dissolved by means of cream of tartar. By adding 2 mols. cream of tartar to 1 mol. stannous hydrate and heating, complete solution of the latter is effected; no doubt the double salt $\text{SnC}_4\text{H}_4\text{O}_6 + \text{K}_2\text{C}_4\text{H}_4\text{O}_6$ being formed. The solution is capable of dissolving even a small quantity of stannous hydrate, or what amounts to the same, it is possible to dissolve 1 mol. stannous hydrate by means of 1½ mols. cream of tartar, in which case the liquid corresponds to a solution of 1 mol. stannous hydrate in 3 mols. of the above double salt. When such a warm concentrated solution is allowed to cool, crystals containing tin are formed, but they have not been further examined.

In all the experiments with tin mordants, the percentage of the latter employed refers to the weight of wool, and is expressed in terms of the equivalent amount of stannic chloride ($\text{SnCl}_4 + 5\text{H}_2\text{O}$).

Stannic tartrate, as a mordant, gives bad results, much of the tin being precipitated in the bath in such a form as not to be subsequently attracted by the fibre.

Stannous tartrate in the form of a solution of 1 mol. stannous hydrate in 1½ mols. cream of tartar proves not to be a satisfactory mordant, since it does not yield a

sufficient amount of tin to the fibre, probably because the solution is not acid enough. Incidentally, it was observed that in dyeing with 15 per cent. cochineal the addition of 4 per cent. sodium bisulphate to the dye-bath improved the red very much, making it yellower and more intense.

The employment of a mixture of 1 *mol.* stannous chloride with 1 *mol.* oxalic acid gives, on the contrary, very good results, an amount (about 4 per cent. $\text{SnCl}_2 + 5\text{H}_2\text{O}$) equivalent to 6 per cent. $\text{SnCl}_4 + 5\text{H}_2\text{O}$ giving the best scarlet on dyeing with cochineal. The fact that the more NaHSO_4 the dye-bath contained the higher is the temperature at which the development of colour takes place, and that the same is observed in the case of increasing amounts of tin mordant, seems to indicate that the tin is fixed on the fibre as a basic salt, while, during the formation of the scarlet-coloured tin-lake, exchanges its acid for the colouring principle of cochineal. The larger the amount of acid present, the higher is the temperature at which the exchange takes place. In this connection, it is strange that the presence of a certain amount of acid in the dye-bath (4 per cent. NaHSO_4) is necessary in order to exhaust the dye-bath more thoroughly, a circumstance which explains why, in practice, good results are obtained in dyeing cochineal-scarlet even when mordant and colouring matter are present in the same bath. If $1\frac{1}{2}$ *mols.*, or even 2 *mols.*, oxalic acid, are employed instead of 1 *mol.*, the results are essentially the same, the main difference being that the colour is yellower; an addition of 2 per cent. NaHSO_4 to the dye-bath suffices.

The general result of the mordanting experiments with mixtures of stannous chloride and oxalic acid is, that although an almost insoluble stannous oxalate is formed in the bath, this is by no means disadvantageous, since the wool takes up the tin most thoroughly. With a mordant equivalent to 1—4 per cent. $\text{SnCl}_4 + 5\text{H}_2\text{O}$, the spent mordant-liquors contain no tin; and even if 10 per cent. be employed, they contain only a small quantity. If the oxalic acid is increased beyond 1 *mol.*, a corresponding increase in the absorption of tin does not take place, but more oxalic acid is taken up; it is not removed by washing, and is probably present as a less basic stannous oxalate. In the case of dyeing with cochineal, it saves acid in the dye-bath, but in the case of other colouring matters—*e.g.*, alizarin—it is injurious.

Dissociation experiments made with a view of explaining why stannic tartrate, stannic chloride, and mixtures of the same give such bad results as mordants, showed that, in dilute solution, all dissociate readily on heating; those containing a mixture of stannic tartrate and chloride dissociate on heating even more readily than stannic chloride alone. To pour the tin solutions into the water is more unfavourable than the opposite mode of dilution. When the wool-fibre is present, dissociation is accelerated, and the condition of the precipitate formed is such that the wool is not able to take it up; the reaction may be called "injurious dissociation." It is evident, from their behaviour, that stannic salts are not suitable as mordants.

Stannous Chloride and Cream of Tartar.—Wool was mordanted with various percentages of stannous chloride + 1 *mol.* cream of tartar. It is best to mix the two salts in the solid state, then stir up with a little water, and afterwards dilute still further. In this way one avoids the dissociation of the stannous chloride, which would occur if the stannous chloride were put into the mordant-bath alone. The stannous tartrate produced in the manner described is not so sensitive. During the mordanting a precipitate is certainly produced, but it is gradually taken up by the wool. Patterns dyed with cochineal exhibit weaker colours than the corresponding patterns in which 1 *mol.* oxalic acid replaces the cream of tartar, and it is evident that less tin is fixed upon the fibre. Strange to say, the cream of tartar colours are yellower in tone, except where no NaHSO_4 is added to the dye-bath, in which case the reverse is obtained. Addition of 4 per cent. NaHSO_4 gives the fullest and yellowest tone of scarlet. The use of 4 per cent. stannous chloride gives a good colour.

With $1\frac{1}{2}$ *mols.* cream of tartar, yellower colours are

obtained than with 1 *mol.* The addition of 4 per cent. NaHSO_4 to the dye-bath behaves as in the previous trial.

The general conclusion is that it is sufficient to employ 1 *mol.* cream of tartar with 1 *mol.* stannous chloride. An increase of the former does not increase the amount of tin fixed on the wool, and its action in causing more level dyeing, producing a yellower colour, and exhausting the bath better, is purely the effect of its acid character; so that the same result can be obtained by adding acid to the dye-bath—*i.e.*, when the colouring matter behaves like cochineal; with alizarin, of course, such an addition would be injurious.

Oxalic acid is preferable to cream of tartar as an assistant in the case of cochineal-scarlet dyeing, since it fixes more tin upon the fibre, and the yellower scarlet given by using cream of tartar can be obtained, if required, either by an addition of more acid or of flavine to the dye-bath, or by mordanting and dyeing in the same bath.

Stannous Chloride and Tartaric Acid.—When mordanting wool with a mixture of stannous chloride and $\frac{1}{2}$ *mol.* tartaric acid, or, as it might be expressed, with a mixture of the following:— $(\text{SnCl}_2 + \text{SnCl}_4 \cdot \text{H}_2\text{O}_6 + 2\text{HCl})$, "injurious dissociation" of the excess of SnCl_2 takes place, which the presence of the stannous tartrate and HCl are not able to prevent. Cochineal only dyes a tolerably useful scarlet when about 5 per cent. $\text{SnCl}_2 \cdot 2\text{H}_2\text{O}$ is employed, although there is fixed on the wool much less tin than in previous trials. With 5 per cent. $\text{SnCl}_2 \cdot 2\text{H}_2\text{O}$ a good orange is obtained, which is considerably improved if the mordanted wool is boiled with water in order to remove the absorbed acid before dyeing. If the dyeing is prolonged, the colour becomes duller, probably in consequence of the formation of stannous sulphide. Nitro-alizarin gives a dull orange. Alizarin-blue S., cerulein-blue S., and gallein do not yield useful colours.

With the addition of 1 *mol.* tartaric acid to the mordanting bath, cochineal dyes slightly better and yellower shades than when 1 *mol.* oxalic acid is employed. With alizarin, yellower shades of orange are obtained.

The authors state that with all the colouring matters they employed, where tin mordant was at all useful, very passable results were obtained, even when only about 1.3 per cent. $\text{SnCl}_2 \cdot 2\text{H}_2\text{O}$ was employed—*i.e.*, equivalent to 2 per cent. $\text{SnCl}_4 \cdot 5\text{H}_2\text{O}$.

With the addition of $1\frac{1}{2}$ *mol.* tartaric acid to the mordanting bath, similar results are obtained, the shades yielded by alizarin being still yellower. Excess of tin yields a dull colour when dyeing with nitro-alizarin. In dyeing with alizarin-blue, if the mordanted wool contains a small quantity of acid, a blue precipitate is thrown down in the dye-bath, with more acid present the precipitate is brown.

When wool is mordanted with stannous tartrate + 1 *mol.* HCl , only a small quantity of useful tin is fixed on the fibre, the largest portion is lost through "injurious dissociation." Cochineal and other colouring matters give dull colours. By mordanting with stannic chloride + 2 *mols.* cream of tartar, a similar result ensues.

From all the foregoing experiments it appears that stannous chloride gives much better results than stannic chloride. The addition of 1 *mol.* tartaric or oxalic acid to stannous chloride is better than an equivalent amount of cream of tartar in cochineal dyeing, because of the greater acidity of the bath.

If a mixture of 1 *mol.* stannic chloride and 1 *mol.* stannous chloride is dissolved in water, a solution is obtained which, even when much diluted, can be boiled without dissociation taking place. After boiling or mordanting wool with this mixture, the filtered spent mordant liquor still contains tin; this shows, therefore, that that portion of tin which is not taken up by the wool is not dissociated on boiling. Although, on dyeing the mordanted wool with various colouring matters, it is evident that little tin is fixed on the fibre, and that the colours obtained are not nearly so good as those given with stannous chloride and an organic acid, still the colours are much better even without the addition of an organic acid in the mordant-bath, than in the case of stannic

chloride with such addition. Some of the "scarlet spirits" of the woollen dyer, prepared by dissolving tin in a mixture of nitric and hydrochloric acids, are evidently similar mixtures of stannic and stannous chloride.

If to a solution of 1mol. stannous chloride and 1mol. stannic chloride, 3mols. oxalic acid are added, turbidity and even a precipitate is produced, but on boiling wool in it the solution becomes clear, and nearly the whole of the tin is taken up by the wool.

If the wool has been mordanted with such an amount of the mixture equivalent to 4, 6 or 8 per cent. $\text{SnCl}_4 \cdot 5\text{H}_2\text{O}$, cochineal gives bright scarlets very similar to those obtained with the use of stannous chloride and oxalic acid. With alizarin very bright reddish oranges are obtained, especially with the highest percentage of mordant mentioned. From the reddish appearance of the orange it is evident that the wool has not taken up very much free acid from the mordant-bath, although the spent dye-baths have invariably an acid reaction. If the mordanted cloth is well washed with a solution of sodium acetate, the wash-water has still an acid reaction and contains a large quantity of chlorides. Cloth so treated gives greyer and duller shades when dyed with alizarin.

It is evident from the foregoing experiments that, although stannic chloride, even with the assistance of an organic acid, is a very unsatisfactory mordant, the addition of stannous chloride in equivalent amount renders it a very good one.

If wool is mordanted with a mixture of $\text{SnCl}_2 \cdot 2\text{H}_2\text{O} + \text{SnCl}_4 \cdot 5\text{H}_2\text{O}$, equivalent to 6 per cent. $\text{SnCl}_4 \cdot 5\text{H}_2\text{O}$ —i.e., the best amount as previously found—with the addition of 1–6mols. oxalic acid + 1–6mols. cream of tartar the turbid baths gradually become clear, since the precipitate is taken up by the wool. If the mordanted patterns are washed with water, those with which only little oxalic acid was used yield turbid wash-water, while with the others the turbidity is only slight. This shows that by increasing the oxalic acid, much less mordant is fixed on the wool in a merely mechanical way. The patterns mordanted with the addition of cream of tartar yield a turbid wash-water. The filtered mordant-baths only contain traces of tin.

In dyeing with cochineal, the addition of sodium bisulphate hinders exhaustion of the bath. Those mordanted with the addition of oxalic acid give a yellower shade than those in which cream of tartar is used, though in both cases the scarlet is very satisfactory. The best results are obtained in each case when 3mols. of the assistant are used.

On dyeing with alizarin, a fine reddish orange is produced, and the baths are not perfectly exhausted in either case, and little is removed in washing. Where only 1mol. of oxalic acid or cream of tartar was used, the colour is much paler, evidently an insufficiency of tin being fixed upon the fibre. Those patterns where oxalic acid was used are much redder in tone, and since the acidity of the bath is larger and tends, according to previous experiments, to produce a yellower tone, the cause of this redness must be that a larger amount of tin is fixed on the fibre. Nevertheless, supposing equal amounts of tin to be fixed upon the fibre, the latter must contain less acid, when oxalic acid is used, than in the case of cream of tartar. On dyeing with nitro-alizarin, all the baths are equally well exhausted, a bright yellowish orange being produced; little colour is removed by boiling water. On dyeing with alizarin blue, the oxalic acid patterns do not exhaust the bath so well as when cream of tartar is used. With the use of 3mols. in each case a full bright reddish-blue is obtained.

On dyeing with corallin, the baths are not completely exhausted, although best in the case of oxalic acid. The dyed patterns show this difference very decidedly. Where cream of tartar is used, blackish-green is produced, whereas in the case of oxalic acid, the colour is much brighter except where only 1mol. oxalic acid is used. The blackish appearance of the corallin colours is always a sign of too little mordant on the fibre, so that a portion of the colouring matter becomes fixed in a substantive manner. On dyeing with gallein, the baths are fully exhausted, except where 1mol. of either assistant

is used. No colour is removed on washing with hot water. Where 1mol. of the assistant is employed the colour is brownish-red, the rest being violet, the oxalic acid patterns having a reddish tone of colour, the others a bluish tone.

The foregoing experiments show that a tin mordant consisting of equivalent amounts of stannous and stannic chloride gives excellent results, especially when used with the addition of organic acids. Stannous chloride alone dissociates on diluting with water; stannic chloride, in the most concentrated mordanting bath experimented with, dissociates at a temperature of 80–90° C., whereas the mixed mordant (Sn_2Cl_6) does not dissociate either on heating or by dilution to the extent usual in a mordanting bath.

Stannic chloride is a bad mordant, even with the addition of organic acids; but by the further addition of stannous chloride its bad properties are masked, and it then gives good, or, sometimes, even better results than stannous chloride and organic acids. It is probable that the "scarlet-spirits" so much esteemed by the woollen dyers for cochineal-scarlet owes its action to the presence of this mixture of stannous and stannic chloride.

The mordant, Sn_2Cl_6 , does not exhibit the "injurious dissociation" to which SnCl_2 and SnCl_4 separately are subject. The best amount of organic acid to use is that which is just sufficient to replace the whole of the chlorine of the Sn_2Cl_6 —i.e., 3mols. oxalic acid or cream of tartar per 1mol. $\text{SnCl}_4 \cdot 5\text{H}_2\text{O} + 1\text{mol. SnCl}_2 \cdot 2\text{H}_2\text{O}$. Without serious detriment even 2mols. of the assistant can be used.

Reckoning that full colours are produced by using an equivalent of 6% $\text{SnCl}_4 \cdot 5\text{H}_2\text{O}$, 1kilo. wool should be mordanted with the following solution: 30 litres water, 19.28grms. stannous chloride, 30grms. stannic chloride, with the addition of either 48.34grms. cream of tartar or 32.4grms. oxalic acid.

Additional experiments have shown that long keeping of stannic chloride or tartrate solutions renders them more sensitive to dissociation, and renders them less efficient as mordants, the dissociation being of an injurious character, since the wool is unable to attract the precipitates formed. Long keeping of a solution of the mordant Sn_2Cl_6 produces a similar condition.

On mordanting wool with a fixed quantity of aluminium tartrate (=6% $\text{Al}_2(\text{SO}_4)_3$) and varying amounts of stannous tartrate—i.e., SnCl_2 ($\frac{1}{3}$ mol. – 1mol.), with addition of 2mols. cream of tartar to each mol. of SnCl_2 , the following observations were made: Where $\frac{1}{3}$ – 1mol. SnCl_2 were used, the baths were turbid, but became clear on boiling; but the wash-water of all the patterns was clear. The filtered mordanting baths showed no trace of alumina; but where $\frac{1}{3}$ – 1mol. SnCl_2 were employed, traces of tin were detected.

On dyeing with alizarin, all the baths are exhausted, and are acid; on washing with hot water nothing is removed.

With increasing amounts of tin, the dyes become yellower. With $\frac{1}{3}$ mol. SnCl_2 the shade is distinctly yellow; with 1mol. SnCl_2 it is a decided orange; the peculiar bluish and somewhat dull red peculiar to alizarin alumina shades is only exhibited where no tin is used.

A further advantage of mordanting with aluminium and stannous tartrate is that the dyed patterns do not rub off, whereas those dyed with aluminium tartrate alone do to a slight extent. The addition of $\frac{1}{3}$ mol. $\text{SnCl}_2 + 1\text{mol. cream of tartar}$ completely prevents rubbing off.

On dyeing with quercitron bark, the baths are pretty well exhausted. As the boiling continues, the yellow colour becomes duller. Alumina mordant gives a pale greyish yellow; with increase of SnCl_2 in the mordanting bath the yellow is redder.

With old fustic, similar results are obtained, the colours being deeper but not so bright.

On dyeing with weld, the baths are very well exhausted. Alumina used alone, gives a bright pale yellow; with addition of SnCl_2 , the colour becomes paler and greener.

A further series of mordanting experiments were made,

in which *aluminium tartrate* and *stannic tartrate* were used, in place of stannous chloride. They gave the following results: The turbidity of the mordanting bath does not disappear on boiling; the mordanted wool, when washed, yields a turbid wash-water, and the filtered mordanting liquors contain no tin.

On dyeing with alizarin, the baths are well exhausted; the dyed fentls lose nothing on washing. The addition of stannic tartrate to the mordanting bath produces no difference of shade, and the colour rubs off just as much as if aluminium tartrate alone had been used, evidently showing that very little tin is fixed on the wool along with the alumina, a result confirmed in the case of dyeing with quercitron bark, old fastie, and weld.

These experiments show that it is irrational to use stannic salts in combination with aluminium salts as a mordant, and that to obtain an effect on dyeing due to a mixed mordant of tin and alumina, one must add to aluminium tartrate a mixture of stannous chloride and cream of tartar.

GENERAL CONCLUSIONS.

From the whole of the foregoing mordanting experiments with aluminium and with tin salts, it is shown that the wool has a number of properties which come into play during the mordanting process.

1. That the wool fibre has the property of attracting finely-divided precipitates of a flocculent nature from solutions and retaining them with considerable power. In the cold this attraction is only feeble, but it increases on raising the temperature, and by continued boiling considerable amounts of such precipitate are boiled on to the wool. The precipitate thus boiled on is removed by washing and rubbing.

If the suspended precipitate is basic aluminium sulphate, the wool is able to retain it moderately fast by virtue of its finely-divided condition, and if, after rinsing, it is dyed with alizarin, the mechanically-fixed alumina is changed into lake, and at the same time to some extent removed from the fibre.

Basic stannic salt precipitates boiled on to the wool in this way only adhere feebly to the fibre, and by rinsing are easily removed. Hence on dyeing, removal of the lake, as above, does not take place. Aluminium mordants which behave in the above manner, yield dyes possessing in a high degree the defect of rubbing off.

2. Wool fibre has the property of extracting acid from acid-liquors, and retaining them with considerable power. As a matter of course, this power varies with the different acids, and at different temperatures. It is known, for example, that wool easily takes up sulphuric acid, retaining it to such a surprising degree that it is very difficult to extract by mere washing in water. The last portions of acid in "extracted wool" (carbonised wool) are only removed by a passage through soda solution.

3. Wool fibre has the property of decomposing certain metallic salts in solution, and this takes place most completely at the boiling-point. On this property rests the possibility of mordanting wool by boiling with salt solutions without any further operation.

It is found that the wool can only decompose the mordanting salts into more or less basic salts, and either free acid or acid salts. This explanation of the reaction which takes place during the mordanting process has much in its favour, and may be deduced from the properties of such basic salts and the corresponding acids.

The authors have found that by boiling wool with aluminium sulphate a white flocculent precipitate separates in the liquors; on rinsing the wool with water the wash-water is clouded with the same, and on dyeing with alizarin a red lake separates already in the bath, a further quantity being removed by the final washing. When examined overhand, the dyed colours are grey and lustreless, and examined underhand possess no intensity. Further, an examination of the dyed fibre under the microscope shows that the alizarin-lake is deposited chiefly on the surface in small particles, and the colours rub off strongly in consequence. The results appear somewhat improved by the addition of sulphuric

acid to the liquor in the proportion of not more than 1mol. to the sulphate employed.

These phenomena are explained in the following manner:—Wool-fibre decomposes the sulphate at high temperatures, and in the presence of water, with great ease into basic and acid salts (see this Journal, vol. ii. p. 537). An insignificant dissociation is sufficient, particularly at the boiling-heat, to form an insoluble basic sulphate from aluminium sulphate, consequently the formation and deposition of insoluble basic salts naturally begin on the surface of the fibre—i.e., before the mordant solution can penetrate to the interior of the fibre. The soluble basic sulphates are absorbed by the fibre, whilst the insoluble basic salts partly adhere to the scales of the fibre and partly float in the liquor.

An excess of aluminium sulphate consequently removes basic sulphate from the fibre (Havrez), and produces poorer results in mordanting. If the wool is boiled with aluminium tartrate no separation takes place in the bath, on rinsing no insoluble compound separates, on dyeing no mechanically adhering lake is removed. The mordanted fibre feels soft, and the dyed fibre, when examined under the microscope, seems equally dyed throughout its mass, and shows no particles of colour-lake on the surface; examined overhand, the fibre is evenly and intensely coloured. In the case of aluminium tartrate, it is evident that since insoluble basic salts are only formed with difficulty, such a deposition on the surface of the fibre is prevented, and the mordant solution can penetrate the fibre unimpeded, and is decomposed only in the interior, the liberated tartaric acid is absorbed by the fibre only in small quantity; the basic aluminium tartrate retained by the fibre changes on dyeing, with the separation of acid, into a coloured lake permeating the whole substance of the fibre.

A similar result is to be expected from tin-salts, but the examination is rendered difficult by their special behaviour.

The tin-salts examined (chloride, tartrate) decompose even on heating their diluted solutions, without the wool fibre being brought into the liquor; the basic precipitates thus formed are not taken up by the wool.

Stannous chloride is dissociated on dilution alone, the separated matter is not taken up by the wool fibre. Stannous oxalate and stannous tartrate, produced in the form of crystalline precipitates by adding oxalic and tartaric acids to stannous salt solutions, are almost insoluble in water, but disappear from the turbid solution and are taken up by the fibre on boiling. Hence they are to be distinguished from the flocculent precipitates caused by the dissociation of stannic salts which are not taken up by the fibre.

From the preceding it follows:—

4. A rational mordant for wool must be so constituted that it must be certainly decomposed by the fibre, but it must at the same time offer a certain resistance to decomposition, just sufficient to allow the solution to penetrate the fibre in its undecomposed state, and be only there decomposed. Therefore all mordants which decompose on the exterior of the fibre, either through the influence of increase of temperature, dilution, or the wool-fibre itself, produce bad results. As it is the acid present which modifies the character of the mordant salt as here indicated, so a substitute for cream of tartar must be a body whose aluminium, iron, etc., salts behave as described above.

5. In general only salts with organic acids comply with the stipulations mentioned in 4.

6. The wool fibre takes up basic salts during the dissociation of mordant liquors, and retains them so firmly that no amount of washing will remove them. That the wool takes up true basic salts, and not hydrates, is shown by the fact that in the authors' experiments, in all cases of dyeing mordanted cloth, the waste dye-liquors show an acid reaction. A rational mordant must necessarily deposit these basic salts in the fibre in such a manner and molecular state that the optical properties of the lake produced are enhanced in the highest possible degree.

7. A special fixing is unnecessary when mordanting wool, the fixing and mordanting taking place together

in one operation. Where possible, the longer boiling in the mordant liquor is always carried out, since it is certain that the mordant already taken up becomes thereby still further dissociated, and a greater saturation of the fibre with mordant takes place.

8. On washing after mordanting, the basic salt taken up is still further dissociated, and the acid thereby produced is partially removed. Free acid is always liberated on the formation of the colour lake in the dye-bath. A further quantity is also introduced by badly-washed wool (carbonised wool), and a thorough washing is hence absolutely necessary in every case where free acid in the dye-bath is injurious, since it prevents the formation of the lake. Where such acid is not injurious, or even advantageous, as with cochineal, a thorough washing of the wool is unnecessary, and the mordanting and dyeing can be carried out in one bath.

9. All the acid cannot be removed from the wool by washing with water, a basic salt invariably remains behind in the fibre; the total removal of the acid is in most cases not necessary for the production of good colours. Such a total removal of the acid can be effected by a treatment with sodium-acetate solution. By dyeing tin-mordanted wool thus treated with alizarin, which permits of exceedingly little acid being left in the wool, the colour is grey and unsightly, which shows that even with alizarin a certain minimum of acid is required in the basic salt on the fibre in order to produce a fine colour (lake). An alkaline treatment of the mordanted wool, or the presence of alkali in the dye-bath, is not conducive to the production of fine colours. The dyes look bare and dull, especially when examined overhand.

10. Acidification of the mordanting bath is in general beneficial, but if this be overdone bad results are then produced; indeed less mordant is then fixed on the fibre. The above conclusions do not profess in the least to give an exhaustive explanation of the processes under consideration. They appear to the authors to be the first conclusions to be drawn from the appearances observed, but a complete explanation of the reactions taking place during mordanting can only be obtained by scientific research, which is already in progress.

The special results of the authors' experiments may be formulated as follows:—

1. Wool always contains fat, however well purified by the ordinary means; if this be extracted by ether better results are obtained on dyeing.

2. An amount of aluminium tartrate equal to 6 per cent. $Al_2(SO_4)_3$ on the weight of wool is very favourable; from 7 to 8 per cent. produces a brighter colour.

3. It is sufficient to mordant with such a quantity of $SnCl_2 \cdot 2H_2O$ (i.e., 4 per cent.) as corresponds to 6 per cent. $SnCl_4 \cdot 5H_2O$, with the addition of organic acids, to produce full colours.

4. Even with the use of $SnCl_2$ corresponding to so little as 2 per cent. $SnCl_4 \cdot 5H_2O$, very fair results are obtained.

5. $SnCl_4$ gives very poor results.

6. Mixed stannous and stannic chloride gives excellent results, but must not be kept in solution.

7. By dyeing with cochineal, it is observed that by mordanting with stannous salts much more acid is taken up by the wool (per each mol. of tin) than with stannic salts; with the latter only a small amount of tin is taken up by the fibre, and although the liquors compared with the stannous chloride liquors are considerably more acid (i.e., for equal amounts of tin), yet less acid is taken up by the fibre.

8. The same holds good in the case of the mordant, consisting of stannous and stannic chloride.

9. When mordanting with $Al_2(SO_4)_3$, 3mols. of cream of tartar should be taken to 1mol. of $Al_2(SO_4)_3$, although in practice it can be reduced by one-half without much interfering with the beauty of colour.

10. On mordanting with $SnCl_2$ and 1mol. cream of tartar, oxalic or tartaric acids, more tin is fixed on the fibre by tartaric acid than by oxalic acid, and both of these acids fix more than cream of tartar.

11. On mordanting with the mixed stannous-stannic chloride, it is best to use 3mols. oxalic acid to 1mol.

$SnCl_2$ and 1mol. $SnCl_4$. Oxalic acid in this case fixes more tin than cream of tartar.

12. For the purpose of mordanting with alumina and tin, the best results are given by aluminium tartrate and stannous chloride, with cream of tartar.

With reference to the colouring matters employed in the above experiments, the following is worthy of notice:—

1. Alizarin gives with alumina mordant a beautiful somewhat brownish red. With tin mordants the most varied shades from dull leather yellow to a deep scarlet coloured orange can be obtained. The less tin and more acid present on the fibre, the duller and dirtier is the yellow thereby obtained. The finest scarlet orange is obtained by employing from 4 to 5 per cent. $SnCl_4$ + $\frac{1}{2}$ mol. tartaric acid. The ratio of 1mol. of $SnCl_4$ + $\frac{1}{2}$ mol. tartaric acid fixes a maximum of tin with a minimum of acid on the fibre, hence the beautiful colour it gives with alizarin. The mixed chlorides of tin give with 3mols. oxalic acid similarly beautiful results.

2. Alizarin orange on unmordanted wool produces a brownish-red shade of orange, with alumina mordant a brownish orange, with tin mordant a brownish-yellow shade of orange.

3. Alizarin blue S. on unmordanted wool produces a light greyish-blue, with alumina mordant a violet-blue, with tin mordant a deep violet-blue; with sufficient tin on the fibre useful colours are obtained.

4. Cœrulein S. on unmordanted wool produces a greenish-blackish grey, which, examined overhand, appears bare and dull; with alumina mordant a somewhat olive-green, which, examined overhand, is very lustrous and full; with tin mordant cœrulein is not applied with advantage.

5. Gallein on unmordanted wool produces a bright reddish but loose brown; with alumina mordant a very beautiful bluish-violet; the same with tin mordant.

6. Cochineal produces with tin mordant the well-known scarlet, which, to a certain degree, becomes yellower the more acid the bath is.

7. Fustie with alumina mordant produces a somewhat greyish-yellow colour, with tin mordant a purer yellow.

8. Quercitron with alumina mordant produces a somewhat greyish-yellow, with tin mordant a fine slightly-less reddish-yellow.

9. Weld with alumina mordant produces a somewhat intense greenish bright yellow; with tin mordant the yellow is still more greenish, but paler than with the alumina mordant.—J. J. H.

On the Influence of Lime and Magnesia Waters in Wool Dyeing. Max Becke. Mitt. des Tech. Gew.-Museums, 123—128, August, 1886.

NATURAL WATER always contains salts in solution, the action of which is of great importance. Water of this sort, when tested, has been found to contain 400mg. of solid matter per litre, consisting of 99.5mg. CaO and 36.2mg. MgO, combined partly with carbonic acid and partly with sulphuric and hydrochloric acids. The following trials are intended to show the influence these quantities of lime and magnesia have on the dyeing of wool.

EFFECT ON THE SCOURING BATH.

If a solution of soap be added to a bath the water of which contains lime and magnesia, a sticky insoluble body (lime and magnesia soap) is formed. This partly floats on the surface of the bath and can be skimmed off, and partly is disseminated as a white amorphous precipitate throughout the bath, giving it a milky appearance. This entails, of course, great loss of soap; it is also injurious to the goods. It seems probable from practical data obtained, that wool washed and soaped in such water, when entered in a dye-bath, is almost always more or less charged with lime soap.

DYEING IN AN ACID BATH.

If this wool is dyed in the usual way with the addition of sulphuric acid and Glauber's salts, the sulphuric acid effects a partial decomposition of the lime soap, forming

sulphate of lime and free fatty acid, which adheres to the wool, and not only gives it a fatty feel, but also becomes dyed, since it acts as a mordant towards many colouring matters, especially those of the triphenyl-methane group. This colour lake adheres only superficially to the fibre, and rubs off—as, for instance, in goods dyed or “topped” with methyl violet or magenta. Alkali-blue, which belongs to this category of colours, is generally dyed in an alkaline bath, and the colour is developed in an acid bath; it also has a strong affinity for all fatty bodies, and consequently dyes not only the wool, but the lime soap as well, and it is well known how much goods dyed with this colour “rub off.”

DYEING WITH ALUM, ETC., IN THE BATH.

When metallic salts are used as mordants, the effect is still worse, for double decomposition takes place with the formation of compounds of the metal with the fatty acid, and an insoluble lime salt (if the metal was present as a sulphate, or if oxalic or tartaric acid were in the bath) which is deposited on the fibre as a whitish powder, giving it an unsightly dusty appearance. The metallic soap formed acts also as a mordant in a double respect, both in consequence of the fatty acid and of the metallic base which it contains; most colouring matters dye these metallic soaps, and frequently these superficial sticky substances have a greater attraction for the colouring matter than the wool itself, consequently becoming more intensely dyed than the wool; this substance cannot be removed by careful washing, but if the goods are dried a simple rubbing with a cloth removes the intensely coloured sticky lake—that is, the goods “rub off.” The appearances here described occur in greater or less degree; with logwood blacks and blues; with cochineal colours; with all anthracene colours; further, in acid baths, to which alum has been added, as is done on the one hand for the better fixing of indigo carmine and also of certain azo-colours, and on the other hand to retard the felting of soft yarn, and to strengthen weak yarn.

ACTION OF LIME IN THE DYE-BATH.

In acid dye-baths the lime only acts in a freshly-prepared bath, first by precipitating a large quantity of the colouring matter, which thereby becomes more or less useless; secondly, by dulling many colours—indeed it forms a dull-coloured lime lake; and lastly, it prevents the equal deposition of the colouring matter, and by this thus hinders the level dyeing of the goods. At the present time a series of azo colours is used in wool-dyeing, all of which have the property of only dyeing evenly when the goods are entered into the dye-bath cold and the temperature gradually raised to the boil. Consequently a fresh bath is always required, and the above-mentioned injurious action of the lime appears in each dyeing operation. The lime in the water produces worse effect, however, with all those colours which require two baths (the mordant and the dye-bath) for their production, as in this case it acts twice. If alizarin blue, carulein, or galloxyanin is used, not only is the depth of colour considerably reduced, but the fibre rubs off to a larger extent as well. Liechti recommends for the correction of calcareous water, the use of caustic soda; in cases where the amount of bicarbonate of calcium and magnesium much exceed the amount of the sulphate and chloride present, it is well to use caustic lime and caustic soda (Gaillet and Huet), and when the sulphate and chloride exceed the bicarbonate, then to apply caustic soda in combination with carbonate of soda or caustic lime and carbonate of soda. Correction by means of caustic lime (Porter and Dixon), or with chloride of barium and lime (De Haen), is not so satisfactory, as in both methods the remaining hardness is not reduced.—J. F. C. S.

Study on the Fixing of Alumina Mordants on Cotton.

Engmont Kutschera and Adolf Utz., Mittheilungen des Tech. Gew.-Museums, August, 1886.

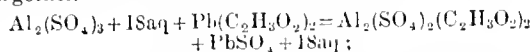
It is the aim in this paper, firstly, to search for a compound of alumina which exhibits specially favourable

properties as a mordant; secondly, to determine which fixing agent is best, and under what conditions it is best applied.

The conditions of all experiments were as far as possible the same, as regards, for example, the concentration and temperature of the liquids, duration of their action, etc. Experiments were made with the following compounds:—

- (1.) $\text{Al}_2(\text{SO}_4)_3, 18\text{H}_2\text{O}$.
- (2.) $\text{Al}_2(\text{SO}_4)_3, (\text{C}_2\text{H}_3\text{O}_2)_2$.
- (3.) $\text{Al}_2(\text{SO}_4)_3, (\text{C}_2\text{H}_3\text{O}_2)_4$.
- (4.) $\text{Al}_2(\text{C}_2\text{H}_3\text{O}_2)_6$.
- (5.) $\text{Al}_2(\text{SO}_4)_3, (\text{OH})_3$.
- (6.) $\text{Al}_2(\text{SO}_4)_3, (\text{C}_2\text{H}_3\text{O}_2)_3, (\text{OH})$.
- (7.) $\text{Al}_2\text{O}_3, \text{Na}_2$.

Such a concentration of the mordant solution was used as yielded a good alizarin red; each contained exactly the same amount of alumina, which corresponded to that contained in a solution of 50grms. $\text{Al}_2(\text{SO}_4)_3$ per kilo. of mordant solution. Nos. 2, 3, 4 were prepared from the calculated amounts of sulphate of alumina, and respectively 1, 2, 3 equivalents of lead acetate. For example, No. 2 is prepared thus: 50grms. $\text{Al}_2(\text{SO}_4)_3$ are dissolved in warm water, and 28.38grms. of $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2$ are also dissolved, the solutions are cooled and mixed together.



the mixed solutions, which now contain 22.68grms. PbSO_4 , are diluted with water till the whole weighs 1022.68grms., and then only filtered, thus avoiding loss of actual mordant, which would occur if filtered previous to dilution. No. 5 is prepared by adding a cold solution of soda crystals to a cold concentrated solution of $\text{Al}_2(\text{SO}_4)_3$ till the precipitate first formed redissolves. This mordant solution naturally contains sodium sulphate. No. 6 is prepared by adding the calculated amount of soda crystals solution to sulphate of alumina, then adding a solution of lead acetate. No. 7 is ordinary aluminate of soda, containing 24.1 per cent. Al_2O_3 , of which 32grms. correspond to 50grms. $\text{Al}_2(\text{SO}_4)_3$.

Padding.—For the experiments, cotton cloth was padded by hand, with the various mordant solutions, using every precaution to ensure that a given surface of the material should contain an equivalent amount of mordant solution. A slight error is unavoidable, as is already shown by L. Liechti, owing to the slight unequal dissociation of the various mordant solutions during the padding process, and also to the fact that it is impossible to pad the middle and sides perfectly equal.

Fixing.—The subsequent fixing is effected in two stages: 1st, exposure to air (ageing); 2nd, the passage through different alkaline baths. After the first operation the padded samples, dried in the cold, are hung in a warm moist atmosphere at the usual temperature (34°C .) for 48 hours. In studying the action of the fixing bath, three points were observed—the concentration of the bath, the temperature, and the duration of action. Having previously learnt that 15grms. of sodium phosphate per litre gave good results, the question of concentration was not further studied, and the other fixing materials were calculated so as to contain an equivalent proportion of alkali, as follows: 15grms. sodium phosphate, 8grms. ammonia (18 per cent.), 12grms. soda crystals, 14grms. commercial ammonium carbonate, 32.4cc. sodium silicate 34°B ., 16.8grms. sodium arsenate. The following were taken arbitrarily as recommended in works on dyeing: 50grms. chalk, 15grms. soap, 20grms. lime (per litre of water). Previous experiments made with ammonium carbonate showed that a better result was obtained by using a larger amount than the 14grms. indicated above, hence a second series of the solutions were made equivalent to 20grms. sodium phosphate per litre. The authors studied the action of the fixing bath at three temperatures—viz., in the cold (12 – 15°), a medium temperature (45 – 50°), and lastly the boiling point; and one noteworthy result obtained is that all fixing agents at high temperatures have a greater or less solvent action, proving therefore

that the well-known unsatisfactory results obtained by fixing at the boiling point are not, as was formerly believed, owing to the dehydration of the fixed Al_2O_3 , which thus became inactive, but to the fact that a portion had been stripped off. Only in the case of fixing with lime could it be concluded that a portion of the fixed alumina had been rendered inactive. The duration of action—i.e., passage in the fixing bath—lasted five minutes, thus securing complete action. After the fixing the samples are carefully washed, then divided, one portion being used to estimate the alumina contained in a given area, the other being dyed with alizarin.

Dyeing.—Samples were dyed with an excess of alizarin, then squeezed, dried, and steamed for three-quarters of an hour without pressure (see abstract, p. 525), half the dyed samples were then soaped at the boil for fifteen minutes, and the amount and quality fixed on the fibre, or, in other words, the mode of action of each fixing agent, was judged of by the appearance of the dyed and soaped samples.

Analysis.—As a general result of these experiments, the authors recommend the mordant $\text{Al}_2(\text{SO}_4)_3(\text{OH})_2$ as the best, because, next to $\text{Al}_2(\text{SO}_4)_3$, it is the cheapest; its solutions, either concentrated or dilute, keep well, and give good results on dyeing. The mordant $\text{Al}_2(\text{SO}_4)_3$ is fixed with difficulty, and gives dull tones of colour on dyeing. Pure alumina acetate is not to be recommended, owing to its expense, and because it gives no better result than Nos. 2 and 3.

The results of the various fixing baths are as follows:

(a) **Water.**—Aluminium sulphate by mere exposure to air, and afterwards washing in the water, deposits only 12 per cent. of alumina on the fibre; on the other hand, the whole of the alumina in Nos. 2 and 4 is fixed.

(b) **Ammonia** as a fixing agent gives poor results; this is not surprising, since alumina is so readily soluble in this liquid.

(c) **Carbonate of Soda.**—Although good results might have been expected from this bath, they are, on the contrary, very poor; the cause of this may possibly be that the evolution of carbonic acid forces off alumina from the fibre. In the most favourable instance only 10 to 12 per cent. of the alumina is fixed.

(d) **Ammonium Carbonate** gives the best result both as to the amount of alumina fixed and the beauty of colour produced, the best results being obtained in the cold, since the salt is decomposed even at 60°C .

(e) **Sodium Phosphate** gives the next best results after ammonium carbonate. This fixing bath gives almost equally good results even at the boil. Whenever, therefore, a warm fixing bath appears to be necessary as in the fixing of printed thickened mordants, the use of sodium phosphate is to be recommended.

(f) **Sodium Silicate** also gives very good results. At a higher temperature it has a greater solvent action than phosphate. The temperature to be recommended both in the case of phosphate and silicate is 45°C , since the solvent action commences from this point. The phosphate gives better colours than silicate.

(g) **Sodium Arsenate**, though so closely related to phosphate, gives much worse results.

(h) **Chalk** at 45° gives very good results with mordant No. 5, but at the boil it is absolutely injurious. The unsatisfactory result may possibly be owing to the formation of basic calcium aluminate, as in the case of lime.

(i) **Lime.**—Although analysis shows that a large amount of alumina is fixed very irregularly, dull pinks are obtained, and since the same result is obtained in cold as well as in warm baths, it is not due to a passive state of the alumina caused by dehydration, but to the formation of calcium aluminate, which prevents the formation of the colour-lake.

(k) **Soap** gives unsatisfactory results. Only a small quantity of alumina is fixed, and the colour is irregular and poor, evidently due to the aluminium oleate melting and being partially removed as an emulsion.

(l) **Ammonium Chloride** used only in connection with sodium aluminate produces good results, as may be expected. If the solution be too concentrated the effect is injurious.

General Conclusions.—From these results it is very evident that boiling fixing baths are very injurious, a fact already well known to practical men. The explanation hitherto accepted is that at 100°C the alumina hydrate loses water, and that the dehydrated alumina remaining on the fibre is inactive and unsuited for the formation of the colour-lake. The authors' experiments show that this idea is false, and that really alumina hydrate itself is removed from the fibre. Experiment shows that alumina precipitated at 100°C , and boiled for a long time with water, loses only one molecule of water; total dehydration of alumina hydrate only takes place at very high temperatures. Noteworthy conclusions arrived at are, that besides the sulphate acetates already used in practice, the basic sulphates and sulphate acetates deserve attention; that the excellence of sodium phosphate and chalk as fixing agents, as already employed in special cases, is fully confirmed; and that ammonium carbonate, if the price allowed, would also rank with them as one of the best fixing agents for alumina.—W. R.

On the Influence of Steaming on the Fastness of Colour-lakes after Dyeing. E. Kutschera and A. Utz. Mittheilungen des Tech. Gew.-Museums, August, 1886

HAVING frequently made the observation that when dyed patterns are dried and steamed they are faster to soaping than those which are not steamed, an explanation of the cause was sought for. The observation was made with aniline colours dyed on antimony tannate or on catechu grounds, further with alizarin and other colours dyed on aluminium, iron or chromium mordants. The greatest improvement is always noticed when the dye-baths are exhausted at a low temperature. Two suppositions for such a change may be offered. First, that the mordant itself, or the colour-lake already fully formed in the dye-bath, is simply better fixed upon the fibre; or, secondly, that during the dyeing operation the colour-lake is incompletely formed, and only completed during the subsequent steaming. If the first supposition is correct, then the amount, both of mordant and colouring matter present in the fibre, would be larger after steaming than before; if the second supposition is correct, then the amount of mordant on the fibre would be the same both before and after steaming, and the deeper colour would be simply due to a larger quantity of colouring matter having been taken up. A trial was made by mordanting cloth with three different amounts of chromium mordant and dyeing with alizarin. The cloth was then divided into two parts, one was dried and steamed, the other not. Finally both were soaped, and the chromium estimated in equal portions of the two patterns. In two cases the steamed patterns contained an increase of chromium, but the shades of the patterns were proportionately much deeper than could be ascribed simply to the increase of chromium, and in a third case where the steamed pattern contained less chromium the tone of the dyed colour was nevertheless deeper, hence the authors concluded that the second supposition is the most likely one—viz., that the steaming renders the colour faster to soaping by completing the formation of the colour-lake initiated in the dye-bath.—W. R.

Chrysamin as a Mordant. M. G. Galland. Bull. Soc. Ind. Mulhouse, 1886, 272.

CHRYSAMIN, which is obtained by the action of salicylic acid on diazotised benzidine—its formula is $(\text{COOH})(\text{OH})\text{C}_6\text{H}_3\text{N}_2\text{C}_6\text{H}_4\text{N}_2\text{C}_6\text{H}_3\text{N}_2\text{C}_6\text{H}_3(\text{OH})(\text{COOH})$ —not only dyes cotton without a mordant, but may, according to Knecht (Bradford), even serve as a mordant for methylene blue, safranin and aniline green. The author has used chrysamin and similar colours, such as benzo-purpurin and azo-blue, as mordants for various dyes with the following results:—Two minutes' immersion in a bath containing 1 grm. chrysamin, 2.5 litres water, and 25 grms. sodium phosphate for each square meter of the fabric, gave a canary-yellow shade. The best results

were obtained with triphenylcarbinol derivatives, particularly with Victoria blue, its dark-blue shades resisting better than the others a soap bath for 1½ hours at 70° C. The shades obtained with aniline violet do not resist a soap bath so well, and if produced by magenta, methylene blue, malachite green, Bismark brown, or safranin, they are entirely decomposed by a soap bath at 70°. Other colours, such as Coupier's grey, the phthalein derivatives—eosin, erythrosin, coerulein; anthraquinone derivatives—alizarin, nitroalizarin; anthraquinoline derivatives—alizarin blue and the natural colours—logwood, Lima-extract, cochineal, etc., are not fixed so well, or not at all, and are all entirely destroyed by soap. Benzo-purpurin and azo-blue behave towards aniline and anthracene colours, as also to the natural colours, like chrysamin, but the shades produced by the latter are faster.—A. R.

Improvements in Apparatus for use in Dyeing or Treating Woven Fabrics. Titus Salt, Saltaire, Yorkshire. Eng. Pat. 13,029, Oct. 29, 1885. 8d.

IN the usual apparatus for dyeing plush velvet or other pieces, a winch frame is pushed along the top of the dye-vat and the winch turned on its axis by hand power. In the improved apparatus these movements are automatically produced by belting driven by steam or water power. Four claims are made with regard to the arrangement of different parts.—T. L. B.

Improvements relating to the Dyeing of Silk, Wool and other Substances. W. R. Lake, Middlesex. From Madame Veuve Gaillot, Lyon, France. Eng. Pat. 13,214, November 2, 1885. 6d.

A DYE-BATH is prepared by boiling roasted chicory in water, the proportions given being "one glass" of chicory powder to the litre. The goods are dyed at the boil, fast shades varying from pale straw to chestnut brown, being produced without any mordants. The residue can be used as a blacking or polish.—T. L. B.

Improvements in Bleaching Cotton, and Apparatus therefor. John C. Clayton. From La Société Leblois, Piceni et Compagnie, Paris. Eng. Pat. 14,637, Nov. 23, 1885. 8d.

INSTEAD of bleaching spun cotton in the form of thread in skeins or on cops, the unspun cotton is treated in the state of carded sliver. The various operations are conducted in a specially constructed vacuum chamber, the sliver being carefully packed in open-work boxes; drawings are given of the various apparatus. The bleaching is completed in two days, the operations being as follows:—

The cotton is exposed to the action of:—I. A bath containing 1 per cent. of quillaria saponaria and ½ per cent. of oxalic acid. II. A special lye made as follows: To 90 litres of "lye" marking 30–32° Bé., add 10 litres of chloride of lime solution of 10 chlorometric degrees, and about 3 grms. potassium permanganate. III. To a bath of hypochlorite, preferably a neutral one. IV. To a washing bath containing 1 to 2 per thousand of ammonia. V. To clean water.—T. L. B.

A Novel Process of Dyeing Wool and other Textile Materials in Spools or Bobbins and other Forms, and Apparatus in connection therewith. W. E. Gedge, London. Eng. Pat. 8317, June 23, 1886. 8d.

IN special apparatus, drawings of which are fully given, the dyeing is effected under the pressure of a column of the dye liquor above the goods being treated. The construction of the apparatus permits the liquid to circulate methodically, the direction of the flow being changed at the desired moment by a simple play of cocks, thus ensuring equal and perfect penetration of all the spools or bobbins, etc. Four claims are made.

—T. L. B.

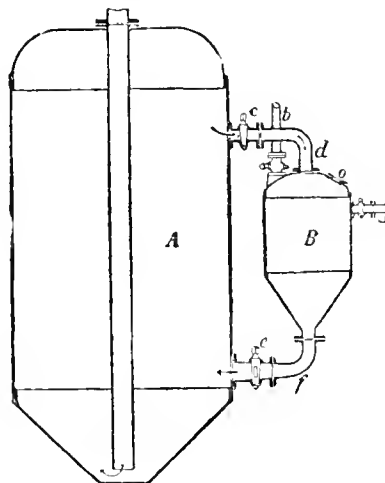
Improvements in Machines for Washing Wool and other similar Materials. Alexandre Deletombe and Amédée Prouvost, Ronbaix, France. Eng. Pat. 9635, July 26, 1886. 8d.

FORKS of the kind used in ordinary circular washing rakes, are so adapted to two endless chains passing over two pairs of wheels, and through guides from end to end of the bath, that having seized the wool, they remain in an upright position until they reach the end of the bath, when they raise the wool and deposit it on the feeding cloth of the wringing press, returning then to recommence work. As the movement of the forks is rectilinear, the change of the surfaces in contact is greater than in ordinary machines, a better scouring takes place, whilst the wool is less "fatigued" and twisted. Drawings are given.—T. L. B.

VII.—ACIDS, ALKALIS, AND SALTS.

Improvements in the Manufacture of Soda by the Ammonia Process. H. Schreib, Salzuflen. Dingl. Polyt. J. 261, 349–351.

IN the usual mode of working the ammonia soda process only 60 per cent. of the sodium chloride is converted into sodium bicarbonate. A portion of the ammonia present escapes the reaction with sodium chloride, and is precipitated as ammonium bicarbonate. In order to better utilise the sodium chloride, and also the apparatus, sodium chloride in a solid form is brought into the carboniser, while the ammoniacal brine is treated with carbonic dioxide. The chloride dissolves in the proportion as the bicarbonate is precipitated, decomposing ammonium bicarbonate and forming another quantity of sodium bicarbonate. To introduce the sodium chloride



a vessel B, holding the salt, is in connection with the carboniser A. By shutting off *c*, and blowing air into B, the liquor in B is forced back into A, and after closing *c*, B can be charged afresh with salt without interrupting the process. The sodium bicarbonate precipitate in the carboniser is separated in the usual manner, whereas the mother-liquor, which chiefly contains sodium and ammonium chloride, is saturated with ammonium carbonate, solid sodium chloride being present. The latter dissolves, whereas ammonium chloride is precipitated and removed by filtering. The mother-liquor now running off contains from 20 to 25 per cent. ammonium carbonate, 24 per cent. sodium chloride, and 9 per cent. ammonium chloride, and re-enters the cycle of operations by being treated with carbonic dioxide in the carboniser, and so forth. The ammonium carbonate required in this process is prepared from the ammonium chloride precipitate and ground limestone.—S. H.

On the Conditions necessary for obtaining Hydrochloric Acid absolutely free from Arsenic by means of Hydrogen Sulphide. Robert Otto. Chem. Zeit. Rep. 10, 169-170.

THE author describes more at length a method for preparing hydrochloric acid perfectly free from arsenic, which he has already given in the 6th edition of F. T. Otto's "Anleitung zur Ermittlung der Gifte, etc." The author and his pupils have found the assumption to be erroneous, that otherwise perfectly pure hydrochloric acid (sp. gr. 1.10-1.12), if treated repeatedly with sulphuretted hydrogen, may be freed entirely from arsenic. But Dr. Bannow has observed that crude spirits of salt may be obtained free from arsenic, by careful treatment with sulphuretted hydrogen, and the author has ascertained the additional fact that the last traces of arsenic, which are not precipitated in pure commercial acid by sulphuretted hydrogen, readily separate as sulphide, if the acid be previously mixed with a certain quantity of any substance which reacts with H_2S , and forms an insoluble body with it. Such substances being invariably contained in crude acid, this is the reason why the latter is so easily purified. Washed sulphuretted hydrogen gas is passed into the crude acid, after, if necessary, diluting to a sp. gr. of 1.12, the latter being continually agitated. When the acid smells distinctly of the gas, it is left in a closed vessel for 24 hours at a temperature of 30-40°, and this treatment repeated until the acid contains an excess of sulphuretted hydrogen. When perfectly clear, the solution is decanted and filtered, and the acid distilled to remove other impurities. The first portion of the distillate, which still contains sulphuretted hydrogen, is collected separately. Then perfectly pure hydrochloric acid comes over, until only $\frac{1}{5}$ of the original fluid remains in the retort. In 5 litres of crude hydrochloric acid, to which 0.1 gram arsenious acid was purposely added, the author could not detect traces of arsenic, after treating in the above way. Under certain circumstances, then, minute traces of arsenic cannot be detected with sulphuretted hydrogen. On the other hand, it must not be forgotten that in judicial examinations a fluid is obtained by the destruction of organic matter with hydrochloric acid and potassium chlorate, which contains substances giving insoluble precipitates with sulphuretted hydrogen, and it may consequently be taken for granted that all arsenic is separated. The author believes that all traces of arsenic contained in otherwise pure sulphuric acid cannot be removed, but that this might occur if a larger amount of arsenious acid or other body which would be precipitated by sulphuretted hydrogen, were added.

—A. R.

Manufacture of Mercury and Sulphurous Acid from Zinc-blende at Oberhausen. F. Bellingrodt. Chem. Zeit. 10, 1039.

THE blende containing 0.02 per cent. mercury is roasted, and the sulphurous acid given off converted into sulphuric acid. It was found that the dust deposited in the flues from the kilns to the towers and chambers contained 6 to 7 per cent. Hg_2 , and that the sludge of lead sulphate at the bottom of the chambers contained 4 per cent. Hg . The mercury is extracted from both flue-dust and lead sulphate. A portion of the gases from the roasted ore is applied to the manufacture of anhydrous sulphurous acid and sulphur. The gases are made to ascend a coke-tower, which is supplied with water. A solution, containing from 12 to 12½ kg. SO_2 per cubic metre of water is obtained, which is deprived of its sulphurous acid by heating. After condensing the steam and drying the gas in a tower filled with solid calcium chloride, it is compressed in a pump to liquid sulphurous acid. The decomposition of sulphurous acid into sulphur is performed in two retorts, one of which is filled with coke and the other with fire-brick. Both are placed side by side and surrounded by fire-gases. The sulphurous acid is decomposed chiefly into carbon dioxide and sulphur, which is conveyed into large condensing chambers.

—S. H.

Preparation of Hydrochloric Acid free from Arsenic. H. Hager. Pharm. Zeit. 1886, 31, 401.

BECKURTS recommends an addition of ferrous chloride to the crude acid; then by distilling fractionally he separates first 30 per cent. containing arsenic, and then 60 per cent. acid free from arsenic; the residue in the retort not being used. Now the author found, that $\frac{2}{3}$ ths of the acid which distilled over first contained arsenic, that the following portion contained traces of iron, the presence of the latter being easily accounted for, as ferrie chloride is volatile with hydrochloric acid gas at 110°. The following method is recommended: Crude spirits of salt are treated with tinned plate shavings. Arsenic separates in flakes, and the acid is filtered through glass wool. Or the acid is treated with copper shavings, to which arsenic firmly adheres, so that it is merely necessary to decant the fluid. It is safer to repeat the treatment. 36 hours are necessary to entirely remove the arsenic if the acid is only macerated with the shavings; a few hours suffice, if gentle heat be applied.—A. R.

Removing Arsenic from Hydrochloric Acid. H. Beckurts. Pharm. Zeit. 1886, 31, 439.

THE author replies to some remarks of Hager on the removal of arsenic from hydrochloric acid by means of ferrous chloride. It was not his object to give a method for producing acid free from arsenic suitable for pharmaceutical purposes, but rather a method for the production of an acid suitable for judicial chemical investigations; in such an acid the presence of a little iron is not prejudicial. The author promises to investigate Hager's proposal to purify the acid by digesting strips of copper in it, and will specially seek to ascertain if the acid can thus be obtained sufficiently free from arsenic and copper.—J. T.

Notes on Hydrated Sodium Sulphides. C. Göttig. J. Prakt. Chem. 34, 1886, 229-237.

By mixing a moderately concentrated aqueous sodium hydrate solution, which is saturated with sulphuretted hydrogen, with an equal volume of a sodium hydrate solution of the same strength, crystals are obtained, testing $Na_2S + 9H_2O$. The solution of those crystals is that used for analytical purposes. Böttger produced crystals with $5H_2O$ by treating an alcoholic sodium hydrate solution in the same manner as mentioned above. The author finds that if the conditions of working are varied, crystals of the following compositions can be obtained:— $Na_2S + 5H_2O$; $2Na_2S + 11H_2O$; $Na_2S + 6H_2O$; $Na_2S + 9H_2O$. If sulphuretted hydrogen be passed into an alcoholic sodium hydrate solution of a specific gravity lying between 0.900 and 0.933, and for the preparation of which alcohol of 96 per cent. to 97 per cent. is employed, a copious crystallisation of silky needles is produced. The same is the case if 75 per cent. alcohol be used, and the specific gravity of the solution is above 0.990; or, if 99 per cent. alcohol be used, and the specific gravity varies between 0.908 and 0.910. If the alcohol is too strong (99.8 per cent.) or too weak (65 per cent.), no formation of crystals takes place. The crystals, however, possess no definite character, being chiefly mixtures of two hydrates, which can be separated by fractional crystallisation. The tables on p. 535 show the results and details of several experiments. Table I. contains the tests of the crystals which appeared first—line needles. Table II. contains the tests of the crystals which were deposited after separating the first crop. They were larger and harder, and sometimes granular shaped.

It thus appeared that the specific gravity of the alcohol employed, as well as the strength of the sodium hydrate solution, have an important influence on the hydration of the crystals. A caustic soda solution, for the preparation of which 99 per cent. alcohol was used, gave, with sulphuretted hydrogen, crystals which, after being left in the mother-liquor for 28 days, contained 26.85 per cent. Na, corresponding with the formula $Na_2S + 5H_2O$. A solution made up with 75 per cent. alcohol gave crystals which, left in the mother-liquor for 30 days,

tested 19.12 per cent. Na, corresponding with $\text{Na}_2\text{S} + 9\text{H}_2\text{O}$. All the experiments go to show that on treating a sodium hydrate solution in strong alcohol with sulphuretted hydrogen, crystals of $\text{Na}_2\text{S} + 6\text{H}_2\text{O}$ are

tact with very strong alcohol, they gradually lose water, whereas they take up water from dilute alcohol, forming $\text{Na}_2\text{S} + 9\text{H}_2\text{O}$. Any of these compounds recrystallised from absolute alcohol yields crystals of $\text{Na}_2\text{S} + 5\text{H}_2\text{O}$;

TABLE I.

	PER CENT.			SPECIFIC GRAVITY.		REMARKS.
	Na.	S.	H_2O .	Of Alcoholic NaOH Solution.	Of Alcohol employed.	
1.	21.19	—	—	1.028	0.901	The crystals tested were made from solutions freshly prepared. They were at once separated from the mother-liquor, pressed between filter-paper, and tested without delay.
2.	21.21	—	—	1.028	0.901	
3.	21.68	—	—	0.910	0.795	
4.	21.20	—	—	0.995	0.860	
5.	21.16	—	—	0.908	0.795	
6.	21.62	—	57.8	0.922	0.809	
7.	21.63	—	—	0.922	0.809	
8.	21.8	—	58.48	0.922	0.809	
9.	21.5	—	—	0.995	0.810	The crystals were in the mother-liquor for one hour before they were tested.
The tests correspond pretty well with the formula, $\text{Na}_2\text{S} + 6\text{H}_2\text{O}$, which requires :—						
Per cent.						
Na = 21.73						
S = 17.20						
H_2O = 58.06						

TABLE II.

	PER CENT.			SPECIFIC GRAVITY.		REMARKS.
	Na.	S.	H ₂ O.	Of Alcoholic NaOH Solution.	Of Alcohol employed.	
1.	—	—	66.3	0.995	0.863	Crystals were at once separated from the mother-liquor.
2.	—	—	67.1	0.995	0.858	} Crystals remained in the mother-liquor for 18 hours.
3.	18.91	—	—	0.995	0.858	
4.	19.2	—	—	0.995	0.858	} Crystals were washed with 99.8% alcohol for some time.
5.	—	—	57.1	0.925	0.808	
6.	26.2	17.86	—	0.910	0.808	S was determined as BaSO ₄
7.	—	18.47	—	0.915	0.808	S was determined as CdS } Crystals were at once separated from the mother-liquor.
8.	26.2	—	—	0.930	0.808	Crystals remained in the mother-liquor for several hours.
9.	25.7	—	—	0.910	0.795	Crystals were at once separated from the mother-liquor.
10.	26.65	—	—	0.910	0.795	Crystals remained in the mother-liquor for 8 hours.
11.	25.15	—	—	0.905	0.808	} Crystals were at once separated from mother-liquor, and washed with 96% alcohol for some time.
12.	25.8	—	57.4	0.920	0.809	
13.	25.2	—	55.7	0.998	0.809	

The first four tests correspond with the formula, Na₂S+9H₂O, which requires : —

Per cent.

Na = 19.17
S = 13.33
H₂O = 67.50

The remainder approaches more closely to the formula, 2Na₂S+11H₂O, which requires :—

Per cent.

Na = 25.93
S = 18.09
H = 55.98

forming in the first instance; the solution gradually becoming deprived of its water, then deposits crystals of $2\text{Na}_2\text{S} + 11\text{H}_2\text{O}$, and afterwards crystals of $\text{Na}_2\text{S} + 5\text{H}_2\text{O}$. All these compounds disappear if the action of sulphuretted hydrogen is continued too long. Left in con-

recrystallised from dilute alcohol they form $\text{Na}_2\text{S} + 9\text{H}_2\text{O}$. Sulphuretted hydrogen, acting on a concentrated solution of sodium hydrate in dilute alcohol, forms $\text{Na}_2\text{S} + 6\text{H}_2\text{O}$ in the first instance, and afterwards $\text{Na}_2\text{S} + 9\text{H}_2\text{O}$.

—S. H.
B 2

Improvements in Plant or Apparatus to be used in the Treatment of Residuals from Copper Works and Chlorine Manufacture to obtain Pigments and Sulphate of Lime. G. L. Wigg, M. Steele, and W. Wigg, Runcorn. Eng. Pat. 11,129, Sept. 19, 1885. 8d.

BOTH pigments and sulphate of lime are prepared from residuals, such as sulphate of iron liquors from copper and other works, and calcium chloride liquor from the Weldon chlorine process. The first part of the plant consists of precipitating and washing vessels provided with mechanical agitators, so arranged that the contents can be run from one part to another by gravitation. The second part relates to apparatus for oxidising and filtering precipitated iron, and is also provided with a reverberatory furnace to dry the precipitate. Means are then provided for the further treatment of oxidised iron, consisting of a combination of horizontal millstones, a washing vessel, a drying bed, a lixiviator, and a roller mill.—S. H.

Improvements in the Manufacture of Sulphur and Ferric Oxide from Alkali Waste by means of Metallic Chlorides. P. Mawdsley, Flint; and T. Macfarlane, Montreal. Eng. Pat. 11,178, Sept. 19, 1885. 6d.

"YELLOW LIQUORS" of 20° Tw. are prepared by lixiviating partially-oxidised alkali waste. The solution of calcium sulphides thus obtained is treated with iron chloride solution from copper-extracting works, or other sources. A black precipitate is formed consisting of iron proto-sulphide and free sulphur, which is filtered, washed and dried at a low temperature. The result is a coarse black powder containing about 70 per cent. of hydrated iron proto-sulphide, and 30 per cent. of free sulphur. The mass is introduced into a small furnace, heated to low redness and constructed on the same principle as the "blind roaster" used in manufacturing salt-cake. The charging doors are then carefully luted, and the heat being continued, the free sulphur is sublimed and carried over into a condensing chamber. After the free sulphur has been driven off, air is allowed to have access to the furnace, when the sulphur of the iron proto-sulphide ignites, forming sulphur dioxide, which is used for producing sulphuric acid in the ordinary manner. After this calcination the residue consists chiefly of ferric oxide in a very fine state of division, and well suited for use as a pigment. Analogous results may be obtained by the use of other metallic chlorides, such as zinc or manganese chloride.—S. H.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Improvements in the Process of Gilding Glass. James Pratt, London. Eng. Pat. 12,014, Oct. 9, 1885. 6d.

THE inventor cleans glass surfaces with chloride of tin—pours thereon the gilding solution, the glass being heated and inclined—preferably after the manner described in No. 515 of 1882. The gilding solution is prepared from chloride gold, 3 parts; caustic soda, 1 part; glycerine diluted, and mannite. The film of gold is thickened and preserved by a backing of silver—deposited from the usual silvering solution.—T.

Improvements in the Manufacture of Articles of Glass, Porcelain, Earthenware, and the like. Jean Marie Beurel, Paris. Eng. Pat. 14,462, Nov. 25, 1885. 4d.

THIS invention is a mode of preventing accidents resulting from the breakage of glass, porcelain, and similar articles by introducing wire net-work into the glass while it is in a melted or plastic state.—T.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

On the Manufacture and Testing of Cement. Dingl. Polyt. J. 261, 344—349.

W. JOY, Northfleet, proposes the introduction of the cement mixture, in a pasty state, into the furnace. The

materials, mixed with small coal or coke, are ground up with water, and the moist mixture is thrown on the top of a heated charge, so that the course of the fire-gases is obstructed, thereby causing a change of current with each addition of the mixture. It is thought to produce by this means a more complete calcination of the mass. The same article gives the standard tests adopted by the Association of German Cement Manufacturers for the uniform delivery and examination of Portland cement. The rules, which are too extensive to be suitable for abstraction, deal with (1) packing up and weight, (2) setting-time, (3) constancy of volume, (4) fineness, (5) power of binding, (6) preparation of samples of neat cement and of cement and sand mixtures to determine the power to resist different kinds of stress.—S. H.

Improved Composition or Cement for use in jointing Stoneware, Concrete, &c. W. Hassall, Beeston. Eng. Pat. 11,001, Sept. 16, 1885. 4d.

FOR use in making castings and the like, oxide of iron from gas purifiers is mixed with gas-tar or pitch, commercially pure sulphur, and either quicklime, limestone, or ground slag, as circumstances may require.—E. G. C.

Improvements in the Manufacture of Cement. R. Stone, London. Eng. Pat. 11,098, Sept. 18, 1885. 8d.

THE inventor claims the use of a mixture of oil of vitriol and petroleum or petroleum spirit, or any other highly inflammable liquids, to be added to the wet slurry in place of the customary admixture of ordinary fuel, as coal, coke, or breeze. The slurry can thus be placed directly in the furnaces or kilns, and the drying and burning are conducted in one operation. A better cement is said to be produced, and at less cost. Draught shafts, of brick, wood, or other material, are also erected by the inventor. In some instances he burns the chalk and river mud, as raw material, without washing, either as above or in the ordinary way; the novelty in this case "being the direct application of the raw material, and the saving of washing, drying, and turning thereby effected."—E. G. C.

Improvements in the Manufacture of Cement. E. W. Killick, Northfleet. Eng. Pat. 11,270, Sept. 22, 1885. 4d.

LIME, chalk, and clay are mixed with suitable fuel, by crushing and grinding, so as to form a stiff pug ready for insertion into the kiln for burning; washing, pumping, and drying being thus dispensed with. One fourth part of the mixture may be made of the fuel.—E. G. C.

Improvement in the Manufacture of Cement. H. H. Lake, London. From U. Cummings, U.S.A. Eng. Pat. 7361, June 1, 1886. 4d.

THE object of the invention is to reduce the cost of the cement by the manufacture of sulphuric acid as a by-product. The materials used are clay or siliceous acid and sulphate of lime, instead of the clay and carbonate of lime usually employed.—E. G. C.

Improvement in the Manufacture of Cement. H. Mathey, New York. Eng. Pat. 7675, June 8, 1886. 4d.

THE inventor claims a process of manufacture consisting in "first crushing the natural cement stone to a suitable degree of fineness, then thoroughly mixing crushed clay with the stone, and burning these elements together in a state of agitation and dissemination; next adding, after burning, a pulverised metallic ore, roasted separately to form an oxide, and finally pulverising the stone, clay, and oxide together."—E. G. C.

X.—METALLURGY, Etc.

The Behaviour of Zinc containing Lead on Re-melting.
E. Kraut. Zeits. Anal. Chem. 25, 169—172.

THIS research was undertaken in consequence of the discordant results obtained in the determination of lead in zinc containing lead. It was found that samples from three plates, prepared by melting the metal and pouring it out in three portions, gave 2.32, 2.92, and 1.72 per cent. lead respectively, and a sample obtained by granulation 4.80 per cent. lead. This zinc was used for the experiments, which were made by melting up the metal in a crucible, well stirring, withdrawing a sample and granulating it, then allowing the remainder to cool slowly and analysing the bottom, the next lowest and top layers of the metal. 1819 grms. of zinc were melted, and the results were:—

Granulated metal	1543	lead.
The bottom layer of the regulus, 43 grms. . .	4.121	"
The layer immediately above this, 223 grms. .	2.847	"
The top layer of the regulus.	0.943	"

The further results are given in the following table:—

Melts	1.	2.	3.	4.	5.	6.
Quantity of Zn used in grms.	2000	1819	1395	710	455	388
Granulated portion, % Lead.	1.656	1.543	1.213	0.936	—	—

Lowest Layer:						
Weight in grms.	45	43	9	—	14	—
Percentage of Lead	5.339	4.121	5.472	—	1.754	1.180

Next Lowest Layer:						
Weight in grms.	—	223	207	—	—	—
Percentage of Lead	—	2.847	1.880	—	—	—
Upper portion, % Lead	1.003	0.942	0.744	0.803	0.610	0.561

From these numbers it will be seen that it is impossible to determine the amount of lead in a zinc by preparing a series of plates and taking a sample from each, and the author recommends that when the metal is melted it should be well mixed by stirring, and a small quantity removed with a ladle and the whole of this taken for analysis.—G. H. M.

Improvements in the Treatment of Ores and Materials containing Sulphur for the Extraction of Metals and other Constituents. Robert Oxland, Plymouth; and Charles Oxland, Sydenham. Eng. Pat. 10,024, August 24, 1885. (d.)

THE mixed ore is digested for about half-an-hour at 600° F. with strong sulphuric acid in suitable vessels connected with a vitriol chamber. All the copper and a portion of the iron, together with silver and gold, are thus rendered soluble, and may be washed from the remaining iron pyrites, which is then available for vitriol making, the copper solutions being treated by any known method. The acid may, with advantage, be mixed with ferrous sulphate from a previous charge, before adding to the ore. By prolonged digestion with much acid nearly the whole of the iron pyrites is attacked; at the same time sulphur is separated, and may be collected in depositing chambers as a marketable product. In treating concentrates from auriferous quartz working in this manner, all the pyrites should dissolve and carry with it but little gold, which may be precipitated by iron; the mixture of quartz and free gold may then be readily amalgamated. If the concentrates are roasted before treatment, a larger proportion of the gold will pass into solution. Bisulphates may be substituted for the free acid in any of these processes.

—W. G. M.

The Recovery of Rich Calcium Phosphate in combination with an Improvement of the Thomas-process. C. Scheibler. Ber. 19, 1883—1893.

THE author, referring to his patent (this Journal, 1885, 226) for separating slags from the Thomas-Gilchrist process into two portions, one rich in phosphoric acid, the other rich in iron, points out that the same effect may be produced by fractionation in the converter itself. According to the ordinary method of procedure with this method, 18 to 20 per cent. of caustic lime is added to the charge in the converter, but the author uses only 12 per cent., which is added in two portions. The operation is

carried out by adding two-thirds of the lime before the fusion of the iron, and then using the blast until the slag is saturated with phosphoric acid, without any very great quantity of iron oxide being formed; the first slag is then run off as far as possible. It is impossible to run off the whole of the first slag, so some always remains in the converter and mixes with the second. After running off the first slag rich in phosphoric acid, the second portion of lime, about one-third, is added, and the charge again blown. A slag rich in iron and poor in phosphoric acid is formed. It is claimed that this method possesses the following advantages:—

1. The required quantity of lime is reduced to at least two-thirds of that formerly required.

2. The length of time of the blow is diminished, since the chemical operations are executed more quickly.

3. The weight of raw iron which can be converted in a single charge is greater.

4. The loss is less than formerly.

5. Greater heat of the charge, and consequently very fluid steel.

6. Dephosphorisation is carried much farther than in the former method, without increasing the loss of iron.

7. Two sorts of slag are obtained as by-products, of which the first contains the greater quantity of the separated phosphoric acid, together with only a small quantity of iron, whilst the second slag contains the greater quantity of the oxidised iron, with only very little phosphoric acid.

The following are analyses of the two sorts of slag obtained at the Thomas-Gilchrist Steel Works, of Hörde:—

FIRST SLAG.

P ₂ O ₅ . . .	27.31	28.10	28.95	31.29	31.50	32.59
SiO ₂ . . .	6.25	4.42	5.45	1.16	4.56	5.19
CaO . . .	53.06	52.27	51.52	—	58.88	60.72
MgO . . .	3.76	4.73	4.60	—	2.54	—
Fe	5.75	6.24	3.82	3.56	1.80	—
MnO . . .	3.47	4.16	4.42	—	2.06	2.16
CaS . . .	0.96	1.19	1.24	—	—	—

SECOND SLAG.

P ₂ O ₅	17.79	16.10	17.26
SiO ₂	4.29	4.38	4.68
CaO	44.78	41.60	43.49
MgO	5.44	2.44	5.81
Fe	19.09	21.01	19.75
MnO	4.45	3.26(Mn)	3.85(Mn)
CaS	0.83	—	0.81

FIRST AND SECOND SLAGS OF TWO CHARGES.

P ₂ O ₅	SiO ₂	Fe	P ₂ O ₅	SiO ₂	Fe
27.65	4.89	4.50	17.30	2.96	22.16
29.67	4.45	4.77	16.93	2.74	23.65

By this method a nearly complete removal of the phosphorus is effected (down to 0.015 per cent.). The first slag forms a valuable manure owing to its high percentage of phosphoric acid, whilst the second forms a valuable raw product for smelting works.

The first slag may be either directly applied to the land in a fine powder, or converted into calcium bisphosphate. The latter is formed by dissolving the slag in hydrochloric acid, adding milk of lime to neutralisation, and filtering the resulting precipitate by means of a filter-press. So obtained, it is a soft white precipitate, which is much more soluble in water saturated with carbonic

acid than the finely-powdered slag. The calcium biphosphate contains 33–38 per cent. phosphoric acid.

The following table shows the great difference in composition, especially in the amount of phosphoric acid, in the ordinary Thomas-Gilchrist slag:—

	P ₂ O ₅	SiO ₂	CaO	MgO	FeO	Fe ₂ O ₃	MnO	CaS	Al ₂ O ₃
Slag from Middlesbro' (Bolekov Vaughan)	8.60	17.78	46.62	5.76	16.71	—	1.22	—	2.45
" " " "	14.26	10.00	50.60	4.96	17.14	—	1.80	—	—
" North Eastern Steel Works....	12.92	9.80	—	—	—	18.51Fe	—	—	—
" " " " " "	16.09	7.42	53.30	2.06	11.70	—	5.70	0.62	4.08
" " " " " "	19.07	7.07	46.91	5.92	9.18	3.78	5.81	1.03	—
" Witkowitz, Mahren	17.20	5.91	46.19	0.76	7.07	11.12	7.14	1.88	—
" Kladno, Bohemia	10.99	11.33	48.28	0.25	12.53	6.93	5.58	0.61	—
" Saarw., (Neunkirchen)	17.28	9.02	50.95	—	—	10.63Fe	—	—	—
" Lothringen (de Wendel)	14.16	6.75	—	—	—	—	—	—	—
" The Rhenish Steel Works.....	14.85	9.91	53.98	—	7.20	3.94	—	—	—
" " " " " "	15.99	7.56	55.22	—	9.15	4.81	—	—	—
" Rothe Erde (Aachen)	17.23	6.60	53.28	2.50	10.66	4.40	3.40	1.06	—
" " " " " "	15.19	10.49	57.12	—	8.29	2.92	—	—	—
" Hörde	17.77	5.87	47.64	—	14.20	—	—	—	—
" "	19.88	4.48	46.00	—	12.0Fe	—	—	—	—
" "	21.23	4.88	48.50	—	12.5Fe	—	—	—	—

—G. H. M.

The Change of Texture of Steel on Heating and Cooling.
J. A. Brinell. Dingl. Polyt. J. 261, 341–344.

STEEL contains carbon either as "cement-carbon" or as "tempering-carbon," and the change of texture of tempered steel is due to the conversion of one state of carbon into the other. Carbon in not-hardened steel is cement-carbon, whereas tempered steel contains tempering-carbon. On examining the changes taking place on heating and cooling heated steel, it was observed that steel cools quicker than iron in the first state of cooling, whereas later on the reverse is the case. This is accounted for by the fact that both iron and steel form crystals on cooling; this formation of crystals is, as it were, so much work performed, which work requires an unequal amount of heat. It is a well-known experience that the same kind of steel often undergoes apparently arbitrary changes of texture on tempering, and experiments were made with a view to detecting these laws, if possible. The Bessemer steel used in these experiments contained: C, 0.52%; Si, 0.13%; P, 0.026%; Mn, 0.48%; S scarcely traces. The author draws the following conclusions from his experiments: If steel loses its coarsely crystalline texture without being hammered, it is owing to the conversion of cement-carbon into tempering-carbon, or *vice versa*. If carbon is to be converted into cement-carbon, steel heated to a white heat must cool slowly to a lower temperature than that to which untempered steel must be heated if its carbon is to be converted into tempering-carbon. The conversion of cement-carbon into tempering-carbon takes place very quickly if the heat is high enough. If tempering-carbon is converted into cement-carbon, heat is always liberated, and it is highly probable that heat is absorbed in the reverse case. If cement-carbon is changed into tempering-carbon—completely or partially—by heating or cooling, a crystallisation is brought about quite suddenly, which is all the more coarsely-crystalline if the steel had already that texture before treatment. By quickly cooling heated steel, the texture is not altered, but the texture, after cooling, is, as a rule, the same as that which the steel possessed immediately before the commencement of cooling. For converting tempering-carbon into cement-carbon not only the right degree of heat is required, but also time, whereas the conversion of cement-carbon into

tempering-carbon only depends upon the right degree of heat. Consequently, quick cooling may prevent the change of tempering-carbon into cement-carbon. The crystallisation of steel also requires the right degree of heat and time, and if the latter condition is not fulfilled

—i.e., by quickly cooling steel—the formation of crystals is diminished or even completely frustrated.—S. H.

Improvements in the Manufacture of Cupels in the Cupellation of Metals and in the Production of other Refractory Apparatus and Materials. F. Maxwell-Lyte, London. Eng. Pat. 10,185, August 27, 1885. 6d.

MAGNESIA, if free from all lime salts other than the phosphate, forms an excellent substitute for bone ash in the manufacture of tests and cupels. The magnesia compound—e.g., magnesite—is highly calcined, and after treatment with dilute hydrochloric acid or magnesium chloride solution, if necessary to remove lime may be re-calcined, crushed, and sifted. It may then be used alone, or mixed with lightly calcined magnesia, or bone ash, or with a metallic oxide or clay to give strength, or sawdust or flour to increase the porosity. After setting, the cupels may be fired or not; whilst setting they should be kept in a moist condition to prevent cracking. A layer of bone ash or bone ash and magnesia should be placed on the top of the cupel.

—W. G. M.

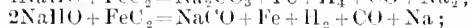
The Utilisation of Waste Tin, Tin Plate, Lead, and Terne Plate. E. R. Blundstone, London. Eng. Pat. 11,624. Sept. 30, 1885. 6d.

THE waste material is to be digested to saturation with hot perchloride of chromium solution, which on cooling will deposit the tin and lead in a crystalline metallic form, the whole operation being conducted in vats in an atmosphere of carbon dioxide.—W. G. M.

Improvements in the Manufacture of Sodium and Potassium. P. M. Justice, London. From H. Y. Castner, New York, U.S.A. Eng. Pat. 7395, June 2, 1886. 6d.

INSTEAD of mixing sodium carbonate with carbon and lime, whereby soda-lime is formed at the high temperature of the retorts, and only about one-third of the sodium contained in the charge is reduced, it is mixed with a metallic carbide. Preferably caustic soda and an

intimate mixture of carbon with metal should be used; the latter is prepared by coking finely-divided iron or oxide saturated with a hydrocarbon, so proportioned as to produce a mass containing 70 per cent. of iron and 30 of carbon. By this reaction, which takes place at a lower temperature than that required in the old process, the whole of the sodium (or potassium) is reduced and distilled, thus:—



and $\text{Na}_2\text{CO}_3 + \text{NaCO} = 3\text{Na} + 2\text{CO}_2$; or, in one equation, $3\text{NaHO} + \text{FeC}_2 = 3\text{Na} + \text{Fe} + 3\text{H} + \text{CO} + \text{CO}_2$. The residual iron and any excess of soda at the conclusion of the process are available for use again.—W. G. M.

XI.—FATS, OILS, AND SOAP MANUFACTURE.

A New Thickening Material for Mineral Lubricating Oils.

L. Marquardt. *Zeits. Anal. Chem.* 25, 159–160.

This new material is the aluminum salt of the higher fatty acids. A ten per cent. solution of it in mineral oil occurs in commerce under the name of “fluid gelatin,” although it does not contain a trace of gelatin. The liquid forms a brown, fairly clear, syrupy, viscous solution, with a tendency to shrink up like gelatin. This “fluid gelatin” is added to mineral lubricating oil to increase its viscosity.

It can be detected in solution in mineral oil by shaking the latter with 95 per cent. alcohol, and then adding ether slowly until the aluminium oleate, etc., separates first in flakes and then in clots; on the addition of more ether it goes into solution again. To determine the amount present quantitatively the following process is recommended:—The oil is heated with dilute hydrochloric acid on a water-bath with frequent stirring. The hydrochloric acid dissolves out the alumina, whilst the fatty acids remain dissolved in the mineral oil. The separated oil is then treated with sodium hydrate solution, which takes up the fatty acids, and the pure mineral oil is then separated from the alkaline solution. The former is then weighed, and the difference between this and the amount taken gives the quantity of aluminium salt present. The result can be controlled by separating the fatty acids from the alkaline liquid with hydrochloric acid and weighing it, and also by determining the amount of aluminium in the same solution in the ordinary way.—G. H. M.

The Elaidin Reaction. Professor Finkener. *Chem. Zeit.* 10, 1039.

EXPERIMENTS are at present going on in the laboratory of the Imperial Board of Trade at Berlin on the testing of pure olive oil. If 10cc. of pure olive oil be treated in a test-tube with 1cc. nitric acid of 1.4 sp. gr. and 0.4 copper filings, a reaction at once takes place, which is finished in half a minute, and is attended by a rise of temperature. On shaking, the red vapours are absorbed, and if the oil be cooled to 12° C. it solidifies in half-an-hour. If nitric acid and copper be replaced by sulphuric acid of 1.53 sp. gr. and a concentrated solution of potassium nitrite, the oil, on shaking and cooling to 10–12° C., does not become solid even after 24 hours have elapsed. Nitric acid of 1.2 sp. gr. and potassium nitrite solidify the oil in 12 hours. Nitric acid of 1.4 sp. gr. and potassium nitrite effect solidification in 3 hours. Nitric acid of 1.4 sp. gr. without any addition does not solidify the oil, whereas equal quantities of fuming nitric acid and water solidify oil in 4 hours. If nitrous vapours are passed through the oil, solidification sets in after a few hours. If copper is replaced by mercury, the action of the acid is delayed. If 0.8 grm. copper is employed instead of half that amount, the phenomena are not altered. If both copper and nitric acid be doubled, the oil requires more time for solidification, and the product of the reaction is softer. If the quantities and proportions between nitric acid and copper are the same, the circum-

stances attending the reaction are always uniform and comparable.—S. H.

On the Chemical Composition of Grease from the Wool of Sheep. A. Buisine. *Compt. Rend.* 103, 66.

THE exudations of sheep, which collect on their wool, are well known to contain substances soluble in water, and substances insoluble in water but soluble in alkalis. The author finds that the substances soluble in pure water contain numerous potassium compounds. He observed the presence of (1) free carbonic acid; (2) ammonium carbonate (by the decomposition of urea); (3) potassium carbonate (due to a peculiar fermentation which goes on at the cost of certain secreted substances); (4) volatile fatty acids—viz., acetic, propionic, butyric, valeric, and capronic acids; (5) higher fatty acids, such as ananthic, capric, oleic, stearic acids, and particularly cerotic acid. These are present as potassium salts, which are formed on the skin or by washing in consequence of saponification by potassium carbonate; (6) fat in the state of an emulsion; (7) phenol as potassium sulphate; (8) lactic acid; (9) benzoic acid; (10) oxalic acid; (11) succinic acid; (12) uric acid; (13) amido acids—viz., glycocyl, leucyl, tyrosyl; (14) colouring matter, the same as in the urine. The aqueous extract of the wool consequently contains all substances (or their decomposition products) generally found in the urine of herbivorous animals. The extracts may become a valuable source for obtaining acetic, propionic, benzoic, lactic, and capronic acids, these being present in considerable quantities. The grease of an Australian wool gave in 100 parts dry residue: 7.1 parts acetic acid, 4 parts propionic acid, 2.6 parts benzoic acid, 2.5 parts lactic acid, and 1 part capronic acid.—A. R.

XII.—PAINTS, VARNISHES, AND RESINS.

Improved Process for Bleaching and Refining Resins and similar Substances. O. Murray, London. From Dr. E. A. Behrens, Bremen. *Eng. Pat.* 11,177, Sept. 19, 1885. *Sd.*

THE resins are treated with benzene, petroleum benzene, bisulphide of carbon, ether, alcohol, etc., so as to obtain complete solution. The solution is then treated with suitable reagents, and separated therefrom. The volatile substances used for dissolving the resins are recovered, and used again.—E. G. C.

Apparatus for the Manufacture of White Lead. J. Haylor, H. S. Read, and H. G. Percival, Middlesex, Herts, and Essex. *Eng. Pat.* 13,115, Oct. 30, 1885. *Sd.*

THE floor of the carbonating chamber is a hot plate, heated by steam or hot water pipes or coils below it, and over this floor is spread a layer of acetic acid. In the middle or other suitable part of the chamber is placed on the floor a box, which receives a supply of air and carbonic acid from without, and the edges of which are immersed in the acetic acid. The sides of the boxes are perforated with numerous small holes, and the gases, mingled with acetic acid vapour, issue from these holes in a diffused condition and distribute themselves over the chamber, in which the pieces of lead are arranged on shelves or frames. The gases pass from the first chamber into a second chamber containing other pieces of lead for conversion. The lead gratings encrusted with carbonate are moved by lifts, travelling bands, or otherwise to the mill in which the carbonate is separated from the metallic lead and prepared for the market.—E. G. C.

An Improved White Pigment. J. B. Freeman, Tottenham. *Eng. Pat.* 13,891, Nov. 13, 1885. *6d.*

THIS invention relates to an improvement in a white pigment already patented by the inventor (*Eng. Pat.*

4879, Oct. 13, 1882), consisting of a mixture of lead sulphate and zinc oxide or sulphide. He now adds barium sulphate, the result being a pigment of greater density, body, and opacity.—E. G. C.

Improvements in "Anti-Fouling" and "Anti-Corrosive" Paints or Compositions. J. Pointon, Liverpool. Eng. Pat. 13,159, Oct. 31, 1886. 6d.

THE inventor claims: "A paint or mixture consisting of ground glass, pulverised slag, or sand, together with linseed oil, a solution of crude turpentine in spirits of turpentine, and a composition, resulting from the combination of the preceding, and possessing the advantages of being practically non-drying, impregnable to water, and 'anti-fouling.'"—E. G. C.

XIII.—TANNING, LEATHER, GLUE, AND SIZE.

Improvements in Tanning and Currying Hides and Skins. W. P. Thompson, Liverpool. From John W. Fries, Salem, U.S. Eng. Pat. 7692, June 8, 1886. 6d.

THE hides, previously unhaired by any of the well-known processes, are suspended in a pit containing a solution of carbonate of protoxide of iron. The carbonate of iron solution can be prepared by dissolving 3lb. copperas and 2lb. bicarbonate of soda per cubic foot of water. After about two days in this liquor, the hides are placed in a solution of 25–40lb. copperas and 15–25lb. common salt per cubic foot of water. After from two to three days the hides are hung up to dry, when (the inventor states) the ferrous oxide is oxidised to ferric oxide throughout the hide substance. The currying of this leather may be similar to that of bark-tanned leather, but the inventor states that a mixture of castor oil and alcohol gives the best result. There are six claims to the patent.—B. H.

XIV.—AGRICULTURE, MANURES, Etc.

Abstract from the Report of the Committee of French and Belgian Chemists on the Methods for Testing Artificial Manures. Chem. Zeit. 10, 875.

Estimation of Nitrogen.—1. If the nitrogen is in the state of nitric acid, Schloesing's method is to be used. The purity of the nitric oxide evolved must be ascertained by its being completely absorbed by acid ferrous sulphate solution. The nitrates must be in aqueous solution. Mixed manures, containing organic matter, are first treated with lime, then extracted with 50 per cent. alcohol. After driving off the latter, the residue is taken up with water and tested for nitric acid. 2. Nitrogen, in the form of ammonia, is estimated by distillation with magnesia. Potassium or sodium hydrate is inadmissible. 3. Nitrogen, in the form of organic compounds, is determined by Will and Varrentrapp's method. 4. Mixed manures, containing ammoniacal and organic nitrogen, are first distilled with magnesia, and then by Will and Varrentrapp's process. 5. Mixed manures, containing nitrates and ammonia, are tested by Schloesing's method and distillation with magnesia. 6. Mixed manures, containing nitrates and organic nitrogen, are tested by Schloesing's method, and, after destroying in a separate operation the nitrates by means of ferrous chloride or oxalic acid, the organic nitrogen is determined by Will and Varrentrapp's process. 7. The total nitrogen is estimated by Dumas' method. Rufflé's process may be used, but only after driving off ammonia. Kjeldahl's method cannot be generally applied, as the presence of nitrates liberates chlorine from any chlorides present which would act upon ammonia.

Estimation of Potassium.—Crude potassium chloride is tested with platinum chloride; in mixed manures, the percentage of potassium must be determined by Corenwinder's method. After calcining the sample before the analysis, the aqueous solution is strongly acidified, treated with an excess of platinum chloride, and evapo-

rated nearly to dryness. The cold residue is taken up with ether-alcohol, filtered, and the crystals on the filter washed with the same mixture. The crystals are then dissolved in boiling water, and the boiling solution is decomposed with sodium formiate, metallic platinum being deposited, which is washed with hydrochloric acid and dried. From it the amount of potassium is calculated.

Estimation of Phosphoric Acid.—The total phosphoric acid is estimated by dissolving the sample of manure in hydrochloric acid, and precipitating the phosphoric acid in a measured portion by means of magnesia citrate and ammonia. The precipitate is filtered after twelve hours' standing, washed, dissolved in dilute nitric acid (1:10), treated with sodium acetate, and titrated with uranium nitrate. Soluble phosphoric acid is determined in the aqueous extract, whereas the reverted phosphoric acid in the residue is made soluble by digestion with ammonium citrate.—S. H.

On the Distribution of the Nitrifying Organism in the Soil. R. Warington.

PREVIOUS experiments conducted at Rothamsted on this subject (*Trans. Chem. Soc.* 1884, 645) had led to the conclusion that the nitrifying organism is always to be met with down to 9in. from the surface, and that at 18in. it is sometimes present; but experiments with soil 2–8ft. from the surface failed to yield evidence of the presence of the organism.

Further experiments have been made in 1885, and during the present year, both in the field with the stiff clay subsoil previously worked on, and in another field having a loamy subsoil; in all, sixty-nine new experiments have been made. The soil in the previous experiments was removed, with suitable precautions, from a freshly-cut surface, and placed in sterilised solutions, consisting of diluted urine—0.4 per cent. It having since been found that the facility with which urine nitrifies is greatly increased by the presence of gypsum (*Trans. Chem. Soc.* 1885, 758), an addition of a small quantity of gypsum was made to the solutions employed in all the recent experiments; rather larger quantities of soil were also employed. The results may be summarised as follows:—

Depth of Soil.	Number of Experiments.	Number of Solutions Nitrifying.	Number Nitrifying out of 10 Trials.
Less than 2ft.	17	17	10.0
2ft.	11	11	10.0
3ft.	11	10	9.1
4ft.	11	7	6.4
5ft.	2	1	5.0
6ft.	9	4	4.4
7ft.	2	0	0.0
8ft.	6	0	0.0

Six of the above experiments were made with chalk, which underlies the Rothamsted subsoil; the chalk was from depths of 5, 6, 7, and 8ft. None of the samples of chalk produced nitrification.

The new results show a far deeper distribution of the nitrifying organism than was concluded from the earlier experiments. The power of producing nitrification is now found to exist generally down to 3ft. from the surface. Below this point, the occurrence of the organism becomes less frequent, though at 5ft. and 6ft. about half the trials resulted in nitrification. With soil from 7ft. and 8ft. no nitrification was obtained. The considerable difference between the earlier and later results is to be attributed to the employment of gypsum in the later solutions. The nitrifying organism in the subsoil is, indeed, less abundant, and probably much more feeble, than in the surface-soil, and is apparently unable to start

nitrification in the decidedly alkaline solution which urine produces in the absence of gypsum.

Although it appears that the nitrifying organism may exist at considerable depths, nitrification is practically confined to the surface-soil. The quantity of nitrogen as nitric acid annually obtained in the drainage-water from soils of different depths in the drain-gauges at Rothamsted is on an average of nine years :—

Soil 20in. deep	40·2lb. per acre
" 40in. "	35·6lb. "
" 60in. "	38·8lb. "

There is no evidence here of a greater production of nitrates when the subsoil is included in the experiment.

Nitrates are always found most abundantly in the surface-soil, unless heavy rain has occurred to wash them downwards. Two fallow soils at Rothamsted were found to contain the following quantities of nitrogen as nitrates in pounds per acre :—

1st 9in.	28·5	40·1
2nd "	5·2	14·3
3rd "	—	5·5
Total	33·7	59·9

Action of Ferrous Iron on Vegetation. O. Kellner Bied. Centr. 15, 442—445.

THE author's experiments with ferrous sulphate on cereals confirm those of Griffiths (*J. Chem. Soc. (Trans.)*, 1884, 71; 1885, 46), that it is without action on these plants. Unlike Griffiths, he considers its beneficial action on leguminous plants is due to indirect, not direct action. The presence of ferrous matter in a soil, although not considered absolutely injurious, is regarded as bad, inasmuch as it indicates imperfect oxidation, which is the constant concomitant of acid humus.—D. A. L.

Stable Manure. A. Audouynaud and E. Zacharewicz. Bied. Centr. 15, 513—519.

IN order to determine to what extent stable manure varies in composition, the authors have investigated the composition of the excreta of cows, receiving the usual seasonable variations in fodder during spring and summer; and of horses rested and more or less worked, receiving oats and lucerne hay in April and May. The results per 1000, compared with those of Boussingault, are as follows :—

	THE AUTHORS.			BOUSSINGAULT.		
	N.	K ₂ O.	P ₂ O ₅ .	N.	K ₂ O.	P ₂ O ₅ .
Cow urine.....	11·20	13·94	—	9·69	12·19	trace
" solid excre- ment.....	4·35	0·43	1·39	4·20	very little	1·0
Horse urine....	15·63	10·56	trace	14·80	8·03	trace
" solid ex- crement.....	5·67	1·32	4·03	5·50	very little	3·0

The animals used by the authors were different from those of Boussingault, and came from a more southerly district. The authors estimate, as a general average, the yield in kilos. per cow per annum to be:—In urine, N 31·5, K₂O 40·8; in dung, N 42—43, K₂O 4·2, P₂O₅ 12; whilst the excreta of one horse will give 37·8 kilos. N, 13·1 of K₂O, and 14·4 of P₂O₅ per annum. To account for the potash in the solid excreta, it is suggested that the organic salts of potassium pass away with the urine, whilst the inorganic potassium salts accompany the solid matter. The authors have, moreover, observed that a considerable proportion of the nitrogen and potash supplied in the fodder does not reappear in the excreta and, in the case of cows, the milk. The nitrogen serves to renew, etc., horns, hair, hoofs, etc., and the potash seems to escape through the skin, inasmuch as in currying cows and horses, from 2 to 2·2 per cent. of potash is found in the dust from the former; and 7·4 to 9·7 per cent. in the brushings from the latter.—D. A. L.

Manuring Experiments with different Phosphates. J. Fittbogen. Bied. Centr. 15, 520—523.

THESE experiments were instituted to test the efficiency of Thomas-slag (containing 19·04 per cent. P₂O₅), Scheibler's precipitate (31·42 per cent. P₂O₅), and Nienburger precipitate (21·66 per cent. P₂O₅). Young barley

plants were sown in pots containing ignited sand, a mixture of potassium chloride, magnesium sulphate, calcium sulphate, ferric oxide, and either mono- or dicalcium phosphate, or one of the above. Harvest results are given in detail and tabulated, from which it is seen that these phosphates can supply barley with sufficient phosphoric acid to produce a normal harvest, provided they are used in quantities double that required of mono- or dicalcium phosphate to produce the same effect; in fact, rather more than double is necessary in the case of Nienburger precipitate; the presence of humus or calcium humate, however, greatly increases the efficiency of these phosphates. It is noteworthy that the Thomas-slag, probably owing to its finely-pulverised condition, is not less active than the precipitates prepared from it. Field experiments were also made with oats on a slightly humic, sandy soil, and with potatoes on a slightly loamy, humic sand. Some lots were unmanured, some received nitrate of soda only, some nitrate and Mejillo's superphosphate, or one of the above. All the phosphates gave nearly the same result, but the Thomas-slag possessed the additional advantage of greater cheapness. Detailed results are given, also directions for sowing the slag.—D. A. L.

Comparative Experiments on Marsh-land with Precipitated Phosphates and Thomas-slag. H. Schöenemark, Berger, R. Rimpau, and Fleischer. Bied. Centr. 15, 524—534.

EXPERIMENTS were made on land newly cultivated and on land which had been in cultivation some time. All plots were manured alike with kainite, and some received in addition varying quantities of the phosphates. On the new land, with oats and barley, when all corrections and allowances were made, the slag and precipitate were found quite equal in action; with potatoes, however, the slag was, to some extent, inferior. A dressing of 25 pounds per morgen (0·63 of an acre) of the phosphatic manure was quite sufficient. On the old land the phosphates produced no effect. An examination of the soil revealed the fact that the "old land" was much richer at the surface than the "new land;" in fact, an examination of the surface sand, taken to a depth of 10cm. from marsh-land, after being respectively 2, 3, 12, 14, 17, 22 years under cultivation, showed that it increased in richness every year of cultivation—at first very rapidly, but afterwards the increase became less marked. This is due to cultivation, aération, production of large crops, and consequent accumulation of crop residue, coupled with the more perfectly decomposed state of the "old" as compared with the "new" soil; and, therefore, the existence of plant-food in an assimilable form for the immediate use of the plant.—D. A. L.

Influence of Light and Heavy Dressings of Nitrogenous Manures on Peas. v. Eckenbrecher. Bied. Centr. 15, 570.

IN continuation of experiments which have been demonstrated, that peas were either indifferent to nitrogenous manuring or were even injured by heavy dressings, it is now shown that the nitrogenous manure applied last year has in no single case produced an effect.—D. A. L.

Formation of Oxalic Acid in Vegetation. Berthelot and André. Compt. Rend. 102, 995—1001; 1043—1049.

THESE experiments were conducted in the manner described (*Bied. Centr.* 15, 261). *Rumex acetosa*, *Amaranthus caudatus*, *Mesembrianthemum crystallinum*, and *Chenopodium quinoa* were the plants selected, and these were examined at all stages of growth for oxalic acid. The juice of *R. acetosa* is always acid; that of *M. cristallinum* is very watery, and at first neutral, but as the plant develops the juice becomes acid; in *A. caudatus* and *C. quinoa*, on the other hand, the juice is either neutral or but faintly acid. In like manner the distribution of soluble and insoluble oxalates varies. For instance, in *A. caudatus* the insoluble form predominates, whilst in the mature *Mesembrianthemum* the oxalic acid is almost wholly soluble.

Rumex acetosa (The Common Sorrel).—The dry seed contains 0.05 per cent. of oxalic acid. Young shoots (June 5) contain 13.9 per cent. oxalic acid, 5.1 per cent. soluble, the remainder in insoluble. The bases in the ash are not sufficient to satisfy all this acid; therefore, some of the oxalic acid is present in the free state. When the plant is in active growth (July 26) it is strongly acid, the acidity (calculated as oxalic acid) amounting to 3.6 per cent. of the dry plant.

Amaranthus caudatus (Loves Lies bleeding).—The juice from this plant contains both nitrates and oxalates, and as these two acids cannot exist together unless both are neutralised, the former is found in combination with potash, the latter combined with lime; and, therefore, the juice is neutral.

Chenopodium quinoa.—The juice is neutral, almost free from nitrates, but rich in oxalates.

Mesembrianthemum crystallinum (The common ice plant).—The seeds do not contain oxalic acid. During earlier periods of growth, the juice is neutral (May 18) or slightly acid (June 9). The percentage of oxalic acid is 7.9 soluble, 1.6 insoluble. Alkalis are abundant in the ash, and lime is present in quantity far in excess of that required for the 1.6 of insoluble oxalates. On the 8th July, the juice from the roots is not acid, but that from the stems and leaves is distinctly so. The soluble oxalic acid amounts to 4.4 percent., the insoluble to 2.0. Soluble oxalates and free oxalic acid preponderate in the leaves. On the 23rd September, when flowering has commenced, the root juice is still not acid, whilst the stems are distinctly so, and the leaves strongly acid. The contrast between *amaranthus caudatus* and *Mesembrianthemum crystallinum*, plants of different habits, is very striking.—D. A. L.

XV.—SUGAR, GUMS, STARCHES, Etc.

Chemical Composition of the Precipitate from a Settling-tank in a Sugar Factory. F. Farsky. Bied. Centr. 15, 436.

THE precipitate was the product of the purification of the refuse water by the addition of lime. It was a fine grained magma, with alkaline reaction. After long exposure to the air it became covered with mould, and emitted an odour of hydrogen sulphide. Its composition was as follows:—Water, 43.584 per cent. Per cent. on the dry matter— K_2SO_4 , 0.1742; CaO , 0.0616; MgO , 0.0043; KCl and $NaCl$, 0.0424; $CaCO_3$, 7.1032; $MgCO_3$, 1.8369; FeS , 0.4833; $Ca_3(PO_4)_2$, 3.8558; SiO_2 , soluble in HCl , 18.5492, insoluble, 40.4342; organic matter, 5.8595; sand, 21.6202. The dry substance contained—N, 0.0324; P_2O_5 , 1.7667; K_2O , 0.0631.—D. A. L.

XVI.—BREWING, WINES, SPIRITS, Etc.

Composition of Brandy. C. Ordineau. Bied. Centr. 15, 562–564 (Compt. Rend. 102, 217–219).

THE author regards the kind of yeast employed for fermentation as the only cause of the difference in flavour of brandy prepared from wine, as compared with brandy obtained from other sources. By repeated fractionation, the following substances were separated from a cognac 25 years old. The numbers are grms. per hectolitre:—Acetic aldehyde, 3.0; ethyl acetate 35.0; acetal 35.0; normal propyl alcohol, 40.0; normal butyl alcohol, 218.6; amyl alcohol, 83.8; hexyl alcohol, 0.6; heptyl alcohol, 1.5; ethyl propionate, butyrate, etc., 3.0; ethyl cenanthyate, about 4.0; amines, 4.0; probably also pyridine. Brandy prepared from potatoes, maize, and sugarbeet, in the ordinary way, by means of beer-yeast, contained propyl alcohol, active and inactive amyl alcohol, pyridine, and alkaloid b.p. 180° to 200°, and isobutyl alcohol; no normal butyl alcohol. In an experiment made with wine yeast, 100 kilos. of refined molasses yielded 19 litres of 92 per cent. spirit, from which a pleasant smelling oil was distilled, containing normal butyl and amyl alcohols, and resembling the oil distilled from new wine. Excellent alcohol was obtained in a similar manner from other saccharine substances.

Wine yeast develops speedily at 28° to 32°, and does not appear to degenerate by repeated cultivation. The bouquet of wines and brandy is due to a terpene, with a b.p. 178°, which is present in large quantities in white wine, and whose oxidation products are so characteristic of old cognac.—D. A. L.

An Apparatus for Testing Brewing Materials. C. R. Bonne, Manchester. Eng. Pat. 9956, August 22, 1885. 4d.

THIS consists of a corrugated metal vessel, which can be heated by immersion in a larger pan containing water. The material to be tested is weighed into the vessel, which is previously tared, and a known quantity of liquor added. The whole is heated for a sufficient time, and the loss by evaporation made up by the addition of fresh liquor. The material is then strained, and the strength of the liquor ascertained with the hydrometer, the readings of which are converted into practical modes of expressing the quality of the material by means of tables.—G. H. M.

Improvements in the Manufacture of Yeast. W. S. Squire, Middlesex. Eng. Pat. 11,935, Oct. 7, 1885. 4d.

Improvements in the Manufacture of Yeast. W. S. Squire, Middlesex. Eng. Pat. 12,058, Oct. 10, 1885. 4d.

Improvements in the Manufacture of Yeast. W. S. Squire, Middlesex. Eng. Pat. 12,463, Oct. 19, 1885. 4d.

THESE consist in growing yeast in saccharine solutions, prepared by mashing either malt alone or malt mixed with raw grain, allowing the mash to sour, straining it bright, and fermenting this wort with yeast, either with or without the addition of spent wash.—G. H. M.

Improvements in the Utilisation of the Refuse or Slops of Breweries, Distilleries, Starch Factories and the like. H. W. Lafferty, Gloucester, U.S.A. Eng. Pat. 9431, July 20, 1886. 8d.

AN apparatus for desiccating brewers' and distillers' grains, etc., for cattle food, without any loss of alimentary constituents, by means of centrifugal separating machines.—G. H. M.

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

(A) CHEMISTRY OF FOODS.

Rancidity of Butter. E. Daclaux. Compt. Rend. 102 1077–1079.

FRESH BUTTER contains a small quantity of free butyric acid, but rancid butter contains a considerable quantity. It is generally supposed that this rancidity owes its origin to a butyric fermentation, resulting from the action of microbes on the nitrogenous matter of the butter. The author, however, has examined a very old butter—it had been to Brazil—and found the nitrogenous matter was still unaltered casein; the liquid expressed from the butter, owing to the salt present, was destitute of microbes; nevertheless, the free acid had increased to 10 or 20 times the original quantity. Evidently this change was not due to the action of microbes, and the author regards rancidity as the result of the inevitable and spontaneous decomposition of the glycerides in butter. All the ethereal salts are, however, not equally susceptible to these attacks; the first to go is butyric, then caproic, and finally the glycerides of the fixed acids. Unaided, the decomposition proceeds but slowly; the presence of water and free acid aid it to a certain extent, but it is chiefly accelerated by the action of microbes, air and light. The action of the last two is accompanied by absorption of oxygen; carbonic anhydride is also evolved, but in volume less than the volume of oxygen absorbed, and various oxidation products are formed, of which the principal is formic acid. The oxidation, however feeble, attacks first of all those substances which give the butter

its odour and taste; and when oxidation has far advanced a taste of tallow is developed. Hence, in making butter, it is advantageous to use cream slightly fermented, therefore free from oxygen, or water charged with carbonic anhydride, etc. With regard to the action of microbes and cryptogamic vegetation, especially the latter, which permeate the butter with their loose, scarcely visible mycelia, they hasten considerably the saponification of butyric, of the glycerides of the volatile acids, and subsequently even the fats and nitrogenous substances. The colour of the butter remains unaltered, except where it is in contact with the mycelia. If the mass is alkaline the fat blackens, owing to the formation of a resin, which is soluble in alcohol and in alkaline solutions. The resin is also formed by the action of sunlight and alkalis. It is an oxidation product. The blackish discolouring of old cheese is due to the same cause.—D. A. L.

Separation of Albumen from Peptones. H. Weiske. Landw. Vers.-Stat. 1886, 33, 147.

SYZMANSKI found that hydrated copper oxide did not precipitate peptone from neutral aqueous solutions, and proposed the employment of this reaction for the separation of albumen from peptones. The author's experiments do not confirm the foregoing. Albumen estimations by boiling with metallic oxide precipitates in presence of peptones, are always too high, and the error increases with the amount of the precipitate and the quantity of the peptones present. Hence, peptone always goes down with the precipitate.—J. T.

(B) SANITARY CHEMISTRY.

Purification of Refuse Water from Factories. A. Müller and Bodenbender. Bied. Centr. 15, 433–435.

THE following experiments were made to investigate the question of self-purification, by means of fermentation of waters containing large quantities of carbo-hydrates, as, for instance, refuse water from sugar factories:—Solutions were prepared with distilled water mixed with 0.5 per thousand of cane-sugar, milk-sugar, or rice-starch; they were impregnated with a nitrifying solution, and put in bottles, some without further admixture, others with the addition of 100 millionths of ammonia as ammonium carbonate, or of ammonia and wood ashes, or of wood ashes, 0.5 per 1000. Two other solutions contained 360 millionths acetic acid, one with ammonia, the other with ammonia and wood ashes. Mould appeared in all cases; least in the pure solutions, most in the ammoniacal. The acetic acid solutions were not favourable to mould formations; they were, however, under favourable conditions, the first to nitrify, and that without loss of nitrogen. After two years at the temperature of the room, there was no ammonia in the solutions containing ashes; whilst the others had lost a good half of their ammonia. With regard to the organic matter, in the pure solutions the cane-sugar showed great power of resistance, both to fermentative and chemical attack, which was less evident in the case of milk sugar; and least of all in the rice-starch. The presence of wood-ash, however, aided the destruction of the cane-sugar considerably; less so the milk-sugar, and even preserved the starch. Ammonium carbonate aided considerably the disappearance of the organic matter in all four cases, with nitrification; considerable in the case of milk-sugar, moderate in the starch, and not at all in acetic and cane-sugar solutions. There was a loss of nitrogen in all except the milk-sugar. Ammonia and wood-ash proved even more active than the ammonium carbonate alone, in working the destruction of the organic matter, which took place with active nitrification, embracing the whole of the nitrogen in the acetic solutions, two-thirds of the nitrogen in the cane-sugar and starch, and half of the nitrogen in the milk-sugar; whilst in spite of the total disappearance of the organic matter in the acetic and milk-sugar solutions, the whole of the nitrogen remained. On the other hand, in all the other cases there was great loss of nitrogen. It is noteworthy that these carbo-hydrates checked nitrification perceptibly, whereas the

mould growth does not interfere with it—perhaps even aids it by clearing the way. The authors conclude that the best mode of purifying such refuse waters, like those from sugar factories, is by means of energetic fermentation, aided by the addition of lime and urine, and supplemented by subsequent irrigation. They remark especially that dressing land under cultivation heavily with carbo-hydrates will cause injurious acidity.—D. A. L.

The Air of Dwellings and Schools, and its Relation to Disease.

THE following is an abstract of the paper on the above subject by Professor Carnelly, D.Sc., Dr. Haldaue, University College, and Dr. Anderson, Medical Officer of Health, Dundee, read before the British Association meeting in Birmingham, in September, 1886.

It is not within the scope of the paper to discuss at length the methods which should be employed for maintaining a reasonably pure atmosphere in schools and in dwellings, but the following suggestions as the result of experience may not be without some value.

(1) As our results show, the state of the air in the Board schools in Dundee is extremely bad and urgently needs improvement. Doubtless the schools in other towns are in a similar condition. Most, if not all, the symptoms ascribed to over pressure which has been complained of so extensively of late, must be largely due to the defective ventilation of the schools. A defective ventilation weakens and depresses the energies, so that a child cannot certainly gain the full advantage of its education under a bad system of ventilation. It therefore behoves School Boards to pay much more attention to the ventilation of their schools than has hitherto been the case. A sufficiently pure air in schools appears to be attainable only by mechanical ventilation. It is true the necessary condition of purity may also be got by the use of open window ventilation, but then, in winter at least, the ill effects of draughts is probably greater than that due to insufficient ventilation. Of the systems of mechanical ventilation it is better to blow air into the room, and allow it to find its own way out (preferably up special shafts), than to ventilate by extraction. Draughts are more easily avoided by the former method. But the great objection to the suction method is that a partial vacuum tends to be produced, which would greatly accelerate the entry of sewer gas into the room from any defective drains, whereas the “blow-in” method has the positive advantage of producing the opposite effect. By blowing warm air into a room a much more uniform and higher temperature may be attained during winter, and this method also is independent of the state of the weather. All parts of the room are more thoroughly heated and ventilated than under the natural system. The air should be blown in under a low velocity through sufficiently large upright shafts in order to avoid draughts. (2) In regard to houses, mechanical ventilation is, of course, out of the question, but very satisfactory results may be obtained in the case of a large block of buildings let out on flats in single or double-roomed houses, as is largely the case in Scotch towns, by having a large open air space or landing on each flat, and provided with open wire-grated windows without glass, so that a good current of fresh air may be maintained along the passages and staircases, whereby a pure, instead of an already vitiated air, enters and supplies the various rooms. (3) The practice adopted in almost all small houses of keeping a lamp burning during the night is one to be deprecated, as it must add very considerably to the contamination of the air, especially in one-roomed houses, in which the cubic space per person is so small. (4) Cleanliness both of person, and more particularly of the dwelling or school, is of the very utmost importance in maintaining the purity of the air as regards micro-organisms, and one which, from this point of view, has not been previously advocated. (5) Though far from deprecating the beneficial effect of abundant air space, yet we think that the frequency with which the air in a room is changed is a far more important point to be attended to in providing a pure atmosphere. (6) Ventilation by mere diffusion should never be depended on alone, for though it may remove a considerable portion of the carbonic acid, it has but little effect

in reducing the organic matter and micro-organisms. (7) It is most important that the windows in houses and schools should be made to open widely, so that at intervals, when the room is not occupied, a good current of air may be sent through the room. This would be very effective in removing the organic matter and micro-organisms.

Micro-Organisms in Drinking Water. Prof. Odling, F.R.S. Brit. Assoc., in Birmingham, 1886.

THE above paper was read by Dr. Odling, as joint author with Drs. Crookes and Tidy. The investigation was undertaken to ascertain the connection between the infection of water and the spreading of disease. He did not deny that certain very clear cases of choleraic or typhoidal outbreak had occurred, which were clearly traceable to drinking water. But still, such instances were very rare, and how is it that so many persons continually drink water to which the excreta of towns has excess without suffering from such diseases? Twenty-five years ago, the sewage of Oxford, of Reading, and of many other places on the Thames, went directly into the river without any pretence of treatment. At that time there was always a percentage of the population of the riparian towns suffering from zymotic diseases, and, therefore, it might have been expected to follow, as a matter of course, that London, which drank the water, would show a higher death rate from these diseases. Yet this was not the case. How is it, then, that although water can be the medium of infection, so little effect follows from drinking, as the people of London then did, a water taken direct from a river polluted and infected at its sources? He considered the theory of germs, or micro-organisms, to be practically established; but, admitting this, it seemed clear that these infectious organisms possessed little power of propagating themselves when removed from their proper nutrient fluids. No doubt it is possible they, for a time, retain vitality; but there are causes interfering with their powers of propagation. The experiments were made with the virus of splenic fever, the well-known wool-sorters' disease. The virus was dissolved in either sterilised distilled or sterilised river water, to form a dilute infected water. After standing a certain number of hours, portions of this water were added to an animal fluid; the virus being thus diluted, and allowed to remain in this condition for some time before being placed under circumstances in which it could possibly reproduce the organisms to which it owes its infectious properties. Micro-organisms thus treated preserve sufficient vitality to allow of their propagating themselves for five or six hours, but propagation does not take place after eighteen hours. It, therefore, appears that dilution effectually protects us from these organisms, by either impairing their vitality or destroying it altogether. Admitting this, it is easy to see how London escaped contamination from the sewage of Oxford and the other towns up the river. To infect the water supply of London with the same proportion of virus as was employed in Dr. Odling's experiments, one million gallons would be required every day, or, considering only that portion of the supply drawn from the Thames, half a million gallons would be required. But the water supply taken from the Thames as it passes over Teddington Lock, is only about one-tenth of the water so passing, which is itself so small, as compared with the whole stream, that its withdrawal causes no sensible diminution of level. Computing this, however, at one-tenth of the whole, it will be seen that 50,000,000 gallons of infection would be required to pollute the Thames water to the extent of the pollution employed in the author's experiments. And even if this enormous and practically impossible quantity of infection could be imparted to the water, the experiments show that the dilution would render it innocuous. Seeing, however, how trifling the real infection must be, compared with this supposition, it would appear that there is little cause for alarm, as far as the Thames is concerned. From calculations he had made, it would appear that if 1,000,000 spores were added to the Thames, there would only be one spore in 50,000 gallons. Spores, of course, opened up a new field

of inquiry, which the authors were now engaged upon. The experiments described were made with the bacillus, not the spore. Spores certainly live longer in water than the bacilli, but they do not propagate. Single spores, moreover, were not necessarily or practically pathogenic. This was seen in vaccination. To perform this satisfactorily, it is not sufficient to introduce the smallest possible quantity of vaccine matter into a single puncture; but, as is well known, it is necessary to make three effective punctures, and even then propagation is not invariable.

Dr. TIDY said he would not, as the time was so short, speak for more than a minute. But he would like to point out that London at the present moment is supplied, to about an equal extent, from the River Lea and from deep wells in the chalk. We should certainly not look for infection from the chalk, but rather from the Lea, which is a stream liable to contamination. As a matter of fact, however, those parts of London supplied from the Lea suffer to no greater extent from zymotic diseases than do those districts supplied from the deep well water of the chalk.

Congo-Red as a Reagent for Free Acid. Prof. H. Schulz, Centr. Bl. f. d. med. Wissenschaft. 1886, 449.

CONGO-RED was used to ascertain whether free acid is formed in lower organisms. The colouring matter is readily soluble in water, and has the advantage of being no hindrance to the organic functions in these animals. In the case of rotatorias the digestive organs were coloured distinctly blue, other parts remaining white. The presence of free acids is thus proved.—A. R.

XVIII.—ELECTRO-CHEMISTRY.

Improvements in Secondary Batteries, Accumulators, or Magazines of Electricity. H. Thame and J. R. Thame, London. Eng. Pat. 12,288, Oct. 15, 1885. 8d.

IN this invention the electrodes consist of tubes of lead, strengthened if necessary by rods or tubes of glass, in which spiral grooves are formed either in the metal itself or by winding on strips or tubes of lead of a suitable section. In these grooves are placed the spongy lead, etc. The electrodes are packed as closely as is possible without touching each other, in frames of suitable material, which are made easily removable. Warping of the electrodes is in this way prevented.—E. T.

Improvements in Galvanic or Primary Batteries. J. E. Liardet, London. Eng. Pat. 12,724, Oct. 23, 1885. 6d.

TO prevent waste of zinc in chromate and bichromate of potash cells, the author proposes a new solution in which sea or salt water and white sulphate of mercury are ingredients.—E. T.

Improvements in the Manufacture of Incandescence Electric Lamps. L. S. Powell and R. P. Sellon, London. Eng. Pat. 1726, Feb. 5, 1886. 8d.

THIS consists of a method for obtaining uniformity of incandescence of lamps under constant conditions of electro-motive force or current. Into each of two vessels containing mercury, but insulated from one another, one end of the filament and a wire from the source of electricity dip; by means of these wires a current at a constant electrical pressure is sent through the filament, and the length of filament outside the mercury is varied, by altering the height of the mercury in some suitable way, until the required degree of incandescence is obtained. The operation is carried on in vacuo or in hydro-carbon gas.—B. T.

Improvements in Incandescent Electric Lamps. Alex. Bernstein, London. Eng. Pat. 3149, March 5, 1886. 8d.

THE improvements relate to that type of lamp in which the light-giving carbon is straight, the conducting wires

being led in at opposite ends of a glass bulb. Each conducting wire is made in two pieces, one piece of platinum wire being sealed into the glass, and another connected to the carbon; these two wires are then joined together by a U-shaped flexible piece of copper at right angles to the direction of the wires. This piece of copper, by its flexibility, prevents any strain caused by the alteration in length of the materials of the lamp, due to changes of temperature, being put upon the carbon filament.

—B. T.

Improvements in the Manufacture of Carbons for Electrical Purposes. J. Kirby, Belgium. Eng. Pat. 8151, June 19, 1886. 6d.

IN tar there is a fine powder held in suspension consisting of 90 to 99 per cent. pure carbon. This carbon is separated from the tar by mixing with one part of tar, two parts of tar-naphtha, creosote or any suitable solvent, and filtered through linen bags; the carbon remains as a black paste, which is pressed to get rid of all tarry matter, and then carbonised in a retort. The product is the material from which the carbons for electrical purposes are made, and is used either by itself or, for cheapness, mixed with graphite from gas retorts. For positive carbons a hollow cylinder is formed of this carbon, and at the time of formation the hollow is filled with plumbago.—B. T.

Improvements in Portable Galvanic Batteries. W. L. Gates, New Jersey, U.S.A. Eng. Pat. 8501, June 29, 1886. 8d.

TO a hollow cylindrical vessel, closed at one end, a similar cylinder of carbon, deeply notched at opposite sides, is fastened at the closed end. In the open end of the vessel is fastened a tightly-fitting plug, supporting a rod of zinc inside the carbon cylinder. The vessel, which is supported in a horizontal position by four legs, has a hopper with a small orifice in the middle of the top. The liquid, which is a solution of bisulphate of mercury and sal-ammoniac, is unable to escape, even when the vessel is inverted, by reason of the pressure of the atmosphere at the small orifice.—E. T.

Improvements in the Treatment of Waste Tin Cuttings to recover Tin and also Iron in a State fit for Re-manufacture, also in Apparatus to be employed in this Treatment. T. Fenwick, London. Eng. Pat. 8988, July 9, 1886. 6d.

THE scrap is suspended in a wicker basket as the anode in a stannous chloride electrolyte, with tin cathodes coated with plumbago, to prevent adhesion of the deposited tin. The tin falls into earthenware troughs beneath the cathodes. The electrolysis, which is performed by a suitable dynamo machine, is not pushed to the complete stripping of the iron, as this would cause solution of some of the latter metal. The partially treated cuttings are therefore next attacked with strong hydrochloric acid, from which the dissolved tin afterwards recovered by electrolysis, the cleaned iron being sold as scrap and available for further manufacture.

—W. G. M.

Improvements in Galvanic Batteries. A. J. Boulton, London. From Dr. O. Lugo, New York. Eng. Pat. 9403, July 20, 1886. 4d.

A CARBON ELECTRODE is placed with the solution of a metallic chloride, such as chloride of copper, in a porous cell, outside which is placed a caustic alkali, such as soda, and a zinc electrode. The deposit of copper on the carbon is obviated by adding hydrochloric acid in the porous cell; the copper is dissolved as soon as formed, and reconverted into chloride. This cell, it is claimed, gives out a constant volt-ampère.—E. T.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Treatment of Hops. L. Boulé. Bied. Centr. 15, 575.

ADHERING LUPULIN is removed mechanically, the hops are then steeped in boiling water, the extract evaporated at a low temperature in a vacuum, dried, powdered, and mixed with the lupulin. The mixture is kept in tin cans, in which the air is replaced by carbonic anhydride. In this way the oil containing the lupulin is not changed into valerianic acid, the hops can be kept any length of time, and can be moreover greatly economised.

—D. A. L.

Phosphoric Anhydride. J. Walter. J. Prakt. Chem. 1886, 34, 133.

PHOSPHORIC ANHYDRIDE in its bulky form can be made much more convenient to handle by compression as follows:—The containing vessel is closed with a caoutchouc cap through which passes a rod with a flattened head. This rod is used to press the anhydride into a cake, out of which small cylinders can be cut by means of a cork-borer or similar instrument. Any metal that may be taken up by the anhydride by this treatment will usually be of no importance.—J. T.

On the Volatile Fatty Acids occurring in the Lupulin of Commerce. J. Ossipow. J. Prakt. Chem. 34, 1886, 238—240.

IF lupulin be distilled with water, volatile acids are found in the distillate, one of which, at least, was supposed to be isomeric with valerianic acid, since oil of hops oxidised with chromic acid gives an acid of the formula $C_5H_{10}O_2$. The acid distillate was therefore saturated with potassium carbonate, decomposed with very dilute sulphuric acid and distilled. The distillate was extracted with ether, and after driving off the ether, the residue was fractionated. The fractions most likely to contain the valerianic acid—viz., those from 170 to 174°—were joined, and a new fraction distilling between 171 and 173° was collected, to be tested for one of the two valerianic acids—methyl-ethyl or isopropyl-acetic acid. Since these two are distinguished by their barium salts, this was prepared from the distillate and examined, as well as the silver salt, but the result does not warrant the author to pronounce an opinion on the constitution of the acid. He intends to try if etherification of the acid will be more successful.

—S. H.

Synthesis of Thalline. Chem. Zeit. 10, 1038.

PHENOL treated with strong nitric acid gives a mixture of ortho- and paranitrophenol. The former is separated by distillation in a current of steam, whilst the latter is converted into the sodium salt and treated with methyl-chloride, forming paranitromethylphenol or paranitro-anisole. The nitro-group is reduced, whereby para-amido-methyl-phenol or para-anisidine is obtained. This is treated with glycerol and sulphuric acid, paramethoxy-quinoline or paraquinanisole being produced (Skraup's reaction), the hydrochloride of which, heated with tin and hydrochloric acid, gives, by the addition of four atoms of hydrogen, the new base tetrahydroparamethoxyquinoline or thalline, which name it received owing to the green colour its most dilute solutions give with chlorine, ferric chloride and potassium bichromate.

—S. H.

Sparteine and its Salts. Grandval and Valser. J. Pharm. Chem. 14, 65, 1886.

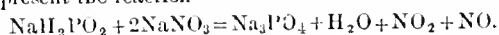
ON adding a little sparteine or one of its salts to a drop of ammonium hydrosulphide on a watch glass, a persistent orange-red colouration appears. This reaction is very sensitive. The normal sulphate $C_{15}H_{26}N_2.H_2SO_4$ is easily obtained by adding the calcu-

lated amount of sulphuric acid to an alcoholic solution of sparteine. The salt crystallises out in the form of large rhombohedra with 8 mols. of water of crystallisation on allowing the solution to evaporate spontaneously in an exsiccator. The salt can also be obtained by evaporating its aqueous solution. On adding an alcoholic solution of sulphuric acid to a solution of sparteine in ether, a very hygroscopic white salt is precipitated of the composition $\text{C}_{15}\text{H}_{26}\text{N}_2 \cdot 2\text{H}_2\text{SO}_4$. In the drying oven it decomposes and takes a red colour. It is usually assumed that the halogen salts of sparteine do not crystallise. The author, however, has obtained a well-crystallised basic hydriodide $\text{C}_{15}\text{H}_{26}\text{N}_2 \cdot \text{HI}$ by treating a warm 5 per cent. solution of sparteine sulphate with an excess of potassium iodide, and allowing the cold solution to evaporate spontaneously. By dissolving these crystals in boiling water, cooling slowly and allowing to evaporate freely in the air, very large crystals of the hydriodide are obtained, which are permanent in the air and light. This salt is not very soluble in water, and is precipitated from concentrated solutions of sparteine salts on adding potassium iodide, a reaction of value in purifying sparteine. The hydrobromide can also be obtained by double decomposition, although it is more soluble. It crystallises in prismatic needles. Similarly the much more soluble hydrochloride can be obtained in the crystalline form.—J. T.

XXI.—EXPLOSIVES, MATCHES, Etc.

An Explosive Mixture. A. Cavazzi. Gazz. Chim. 16, 172.

THE author found that sodium hypophosphite heated with sodium nitrate violently exploded. The greatest effect was produced with a mixture of equal parts of the salts. The author supposes the following equation to represent the reaction—



—J. T.

XXII.—GENERAL ANALYTICAL CHEMISTRY.

Properties of Oxycellulose, applied to the Determination of Vanadium. G. Witz. and F. Osmund. Bull. Soc. Chim. 45, 309—315.

WITZ first used vanadium for developing aniline-black in calico printing. Cotton-wool slightly altered by oxidation, as it is obtained, for instance, by steeping in chloride of lime solution (cf. 2^e Bé. for one hour at the ordinary temperature, is able to fix vanadium from very dilute solutions—according to Witz if the solution contains 1 gm. vanadium in 1000 cc. water—and prove its presence by developing aniline-black. The authors propose to test solutions for vanadium by soaking a cotton material partly converted into oxycellulose in the solution, washing and drying the material, and then printing with an aniline-black mixture free from metals and developing the black. Vanadium baths, which contain from 0.1—0.000001 mg. vanadium in a litre, give this reaction distinctly, and the weakest bath gives a result very different from a bath free from vanadium. The reaction is most delicate with vanadium dichloride in the absence of other salts. With the aid of this reaction it is possible to find vanadium in different well-waters. It has not yet been found in animal bodies.

—G. H. M.

Determination of Glycerol. William Fox and J. A. Wanklyn. Chem. News, 53, 15.

THE authors determine glycerol by oxidising with permanganate and titrating the oxalic acid which is obtained according to the equation, $\text{C}_3\text{H}_8\text{O}_3 + \text{O}_6 = \text{C}_2\text{H}_2\text{O}_4 + \text{CO}_2 + 3\text{H}_2\text{O}$. The aqueous solution of glycerol, which should not contain more than 0.25 gm., is made alkaline with 5 grms. of caustic potash, and boiled for half-an-hour with an excess of permanganate. Excess of the latter

is then removed with sulphurous acid. After acidifying with acetic acid, calcium chloride is added, and the precipitated oxalate determined in the usual way by titration with permanganate.—A. R.

Detection of the so-called "Saccharine." Reischauer. Bied. Centr. 15, 492—493.

THE concentrated solution of the sugar, (if alkaline, slightly acidified with phosphoric acid), is extracted with ether. If saccharine is present, the residue from the ether melts at about 200°, and when fused with a mixture of nitre and sodium carbonate the fused mass contains sulphuric acid, which may be determined in the usual way. The weight of BaSO_4 obtained in this manner from 100 grms. of sugar, multiplied by 0.785, gives the weight of the saccharine extracted.—D. A. L.

Estimation of Fusel Oil in Brandies and Liqueurs. J. Traube. Bied. Centr. 15, 559—560.

ONE-FIFTIETH per cent. of fusel oil in a brandy can be detected by the following method:—A thin-walled, very fine capillary tube is attached to an adjustable scale divided in half-millimetres. The brandy or liqueur to be examined is distilled, and the distillate diluted with distilled water until the sp. gr. corresponds to 20 per cent. alcohol; this liquid is sucked up the capillary tube two or three times, and a few hours after the liquid has come to rest, the height of the column in the capillary tube is read off and compared with a standard. An error of a half per cent. in sp. gr. is of no importance, and a very slight correction is required for variations of temperature. The height of the column is lowered by fusel oil, and to a less extent by other alcohols and aldehydes present in brandy, etc.—D. A. L.

Practical Experience with the Diphenylamine Reaction in Milk and Wine Analysis. Joseph Herz. Rep. Anal. Chem. 6, 360.

ON the occasion of the dairy exhibition at Munich, in 1884, Soxhlet altered Uffelmann's method in the following way: 100 cc. milk are boiled with 1½ cc. of a 20 per cent. calcium chloride solution, a few drops of a 2 per cent. solution of diphenylamine in conc. sulphuric acid added to the filtrate, and a layer of about 2 cc. of the now turbid mixture carefully poured on to conc. sulphuric acid, so that the fluids do not mix. In presence of nitrous or nitric acid a blue zone becomes at once apparent, but if 1 mgm. in 100 cc. is present, the colour is observed after the lapse of a few hours only. With still smaller quantities it is necessary to coagulate 450 cc. milk with 6—7 cc. calcium chloride solution, and after adding 2 cc. conc. sulphuric acid to the filtrate, to distil off 120—150 cc. The distillate is made slightly alkaline, evaporated in a platinum dish to about 5 cc., and now examined as above. All reagents and the distilled water must be previously tested for nitric acid.

This method is not employed at Würzburg, as the water there does not contain less than 25 mgms. nitric acid in the litre. Those who examine the milk there have to rinse the vessels used with the milk about to be examined. Coagulation is effected on the water-bath, and, in the case of a positive result, the experiment repeated with some of the distilled water used. A negative result does not necessarily prove that water has not been added; even more so is this the case with wine, for it was not possible to prove the presence of nitric acid in old wine which had undoubtedly once been mixed with water.—A. R.

On the Quantitative Determination of Phenol as Tribromophenol. H. Beckurts. Arch. Pharm., 1886, 24, 561.

THE product of the action of bromine on phenol, tribromophenol, was examined and found to have an admixture of tribromophenolbromide $\text{C}_6\text{H}_2\text{Br}_3\text{OBr}$. It is due to the formation of the latter compound that the quantity of phenol is frequently found too high, since for

the production of tribromophenolbromide, 8 atoms of bromine are used for one mol. of phenol, whereas in the formation of tribromophenol only 6 atoms of bromine are required.

Tribromophenolbromide is decomposed, according to Koppeschaar, as shown in the following equation: $C_6H_2Br_3OBr + 2KI = C_6H_2Br_3OK + KBr + I_2$, i.e., 2 atoms of iodine separate which are equivalent to 2 atoms of bromine, and are retitrated with thio-sulphate, so that only 6, not 8, atoms of bromine are used for 1 mol. of phenol. Addition of potassium iodide, consequently, is of much greater importance than is assumed by Koppeschaar, who only desired to replace bromine by iodine, which is more readily determined. Titration is best effected with $\frac{1}{10}$ normal potassium bromide solution, $\frac{1}{75}$ normal potassium bromate solution, $\frac{1}{10}$ normal sodium thiosulphate solution and a solution of potassium iodide, which contains 125 grms. in the litre. Into a bottle furnished with a well-fitting glass stopper, 25—35cc. of the phenol solution (1:1000) are introduced, 50cc. each of the potassium bromide and bromate solution and 5cc. conc. sulphuric acid added and the mixture well shaken. After 10—15 minutes the bottle is opened, 10cc. of the potassium iodide solution added, and after a few minutes the separated iodine is titrated with $\frac{1}{10}$ normal thio-sulphate solution. The calculation is simple: in a mixture of 50cc. each of potassium bromide and bromate solution, sulphuric acid sets 0.2393 grm. bromide at liberty, according to the equation: $5KBr + KBrO_3 + 3H_2SO_4 = 3K_2SO_4 + 3H_2O + 6Br$. This quantity of bromine would convert 0.0463 grm. of phenol into tribromophenol. One cc. of one-tenth normal thio-sulphate solution corresponds to 0.0082 grm. bromine, and this combines with 0.00156 grm. of phenol. By subtracting for each cc. of $\frac{1}{10}$ normal thio-sulphate solution, which has been used for estimating the iodine set free by the bromine, 0.00156 from 0.0463, the quantity of phenol is found, which was present in the volume of the phenol solution originally employed. The method gives very good results.—A. R.

Determination of Phenol in Crude Carbolic Acid. II. Beckurts. Arch. Pharm. 24, 572.

KOPPESCHAAR'S method for determining phenol (see previous abstract) cannot be used for crude carbolic acid, as considerable quantities of cresols and other homologous phenols are contained in it, and these form different compounds with bromine, so that the quantity of phenol is always found too small. As a general rule, the method is of course sufficiently exact for ascertaining the quantity of phenols in the crude acid, irrespective of the kind of phenols it contains. The author uses a method which is a modification of Crookes'. A certain volume of crude carbolic acid is mixed with the same volume of petroleum ether, and shaken with a sufficient quantity of a 10 per cent. caustic soda solution in a graduated cylinder. After ten minutes, a perfect separation of the alkaline fluid and of the hydrocarbons has taken place. By subtracting the known volume of petroleum ether from the portion insoluble in caustic soda, the amount of neutral oils and resinous substances contained in the acid is found. A portion of the alkaline fluid is mixed with excess of conc. hydrochloric acid, and the volume of phenol which separates out, noted. No corrections are necessary, as the phenols dissolve as much water as the hydrochloric acid dissolves of the phenols. The method gives good results.—A. R.

A Modification of Lundin's Method for Determining Arsenic in Iron and Iron Ores. V. Gröndahl. Jernkontorets Annalen, 41, 149.

THE author finds fault with Lundin's method for determining arsenic acid, because it is difficult to remove the sulphuric acid used for dissolving the iron, in consequence of which wrong results are obtained, for on addition of hydrochloric acid, chlorine is evolved, which, in its turn, separates sulphur from sulphuretted hydrogen. In order to avoid these mistakes, the following modifica-

tion is recommended:—6 grms. pig-iron, steel, or cast-iron are dissolved in 60cc. nitric acid (sp. gr. 1.2) in a beaker holding at least 300cc., and the solution evaporated to dryness in a porcelain dish holding 150cc. The residue is powdered, transferred to a porcelain crucible, and fused until nitrons fumes cease to be evolved. The ignited mass is returned to the dish, 10cc. sulphuric acid (sp. gr. 1.83) added, and excess of sulphuric acid evaporated. The dry mass is then rinsed into a 300cc. flask with 60cc. hydrochloric acid (sp. gr. 1.19). The distillation, which is the next operation, and precipitation with sulphuretted hydrogen, is again carried out according to Lundin. It is needless to pass carbonic acid into the distillate, unless the precipitate produced by sulphuretted hydrogen is to be filtered with all possible speed through a weighed filter. After washing with warm water, the filter and precipitate are dried at 100—110° and weighed.

In determining arsenic in iron ores, it is advisable, after dissolving in nitric acid, to digest with hydrochloric acid (sp. gr. 1.19), and not, as Lundin recommends, with nitric acid.—A. R.

Determination of Invert Sugar. Deutsche Zuckerindustrie, 11, 1229.

WITH regard to Wolf's modification of Biggart's method, Brauns and Volpert find that, by using a $\frac{1}{2}$ per cent. solution of invert sugar and 50cc. copper solution, inaccurate results are obtained, if the amount of sugar is small. According to Volpert, 10cc. of Soxhlet's copper solution, diluted with 40cc. water, require, if boiled for two minutes, 25 Sec. of a $\frac{1}{10}$ per cent. solution of invert sugar. If the 40cc. water contain pure cane sugar (e.g., 2, 4, 40 grms.), a smaller number of cc.'s are used—namely, 23 S, 22 S, 20 S—the decrease not being a regular one, however.

11 grms. crude sugar are dissolved in about 100cc. of water, precipitated with a little lead acetate, and made up to 110cc. 100cc. (10 grms.) are filtered off, the lead precipitated with Glauber's salt, the solution diluted to 200cc., and again filtered. Each 40cc., containing 2 grms. sugar, are boiled with 10cc. copper solution (according to Herzfeld) for half-a-minute. A small portion is then tested with acetic acid and ferrocyanide, a further quantity of copper solution introduced, again tested, etc. Generally, three tests suffice. Under these circumstances, and for 2 grms. of sugar in 40cc., 0.1cc., more or less, represents 0.01 per cent. invert sugar; each whole cc., therefore, representing 0.1 per cent.—A. R.

Acidimetric Determination of Sulphurous Acid. Ch. Blarez. Compt. Rend. 103, 69.

SULPHUROUS ACID behaves differently towards the various indicators. Thus, its basicity seems to be twice as great when phenol-phthalein is used than when cochineal and helianthin are employed as indicators. Sulphomagenta, litmus, and Porrier-blue C4B cannot be used. Each cc. of a $\frac{1}{10}$ normal alkali solution is equivalent to 0.0032 grm. SO_2 , if working with phenol-phthalein, and equivalent to 0.0064 grm. SO_2 if with cochineal or helianthin. The acidimetric determination of free sulphurous acid in presence of other free acids is only possible if the mono- or polybasic acid is so strong as to show its absolute basicity towards cochineal or helianthin. In this case, a determination is made, using one of the latter indicators, and another with phenol-phthalein. The difference expressed in cc. $\frac{1}{10}$ normal alkali solution, if multiplied by 0.0064, gives the weight of anhydrous sulphurous acid contained in the volume of the solution experimented upon. Good results were obtained in presence of nitric, hydrochloric, sulphuric, and oxalic acids.

With regard to sulphites, the following holds good:—Acid sulphites, with an excess of sulphurous acid, seem acid towards cochineal and helianthin, and by means of these indicators and alkali the excess of sulphurous acid may be determined. Acid sulphites are neutral to the last-mentioned indicators, acid to phenol-phthalein; they moreover absorb the same quantity of alkali as

they already contain before the red colour of the former becomes apparent. The neutral sulphites, alkaline to cochineal and helianthin, neutral to phenolphthalein, are converted into acid sulphites by addition of the same quantity of sulphurous acid as they already contain, and their quantity can be thus determined; only it is better to take $\frac{1}{10}$ normal hydrochloric acid solution instead of sulphurous acid. A small excess of the former is added, cochineal or helianthin are used as indicators, and the change of colour is effected by $\frac{1}{10}$ normal alkali solution.

If a sulphite is under examination, which for 1mol. of sulphurous acid contains more than 1mol. and less than 2mols. of alkali, the exact composition may be determined in the following way:—(a) A certain volume of the solution is titrated with alkali until a change of colour in the phthalein appears. (b) The same volume of the same solution is treated with an excess of $\frac{1}{10}$ normal hydrochloric acid, and excess of the latter found by means of $\frac{1}{10}$ normal alkali solution. The sum of the volume of alkali used in a, and the volume of acid actually required in b, calculated for sulphurous acid, gives the quantity of this acid in the volume of fluid examined. If the weight of the sulphurous acid be known, and also the amount of alkali necessary for transformation into neutral sulphite, then the difference represents the weight of combined alkali, and the exact composition of the body is thus ascertained.—A. R.

Estimation of Silver in Burnt Pyrites. E. Thilo. Chem. Zeit. 10, 822, 1065—1066.

THE amount of silver present in burnt pyrites is usually 0.003—0.008 per cent. To obtain accurate results it is desirable to deal with a quantity of pyrites containing 0.01grm. of silver, say 300—500grms. For so much material, scorification and cupellation are not suitable. Methods involving the solution of the whole of this material, hold out no promise of success. Attempts were made to devise a process by which the whole of the silver could be dissolved without taking up the rest of the material. Nitric acid was hardly suitable as a solvent owing to the possible presence of chlorides. Chlorination and subsequent extraction of the silver chloride was tried. Digestion with chlorine water proved better than passing chlorine over the heated material, but bromine water was much more convenient than chlorine water, and attacks silver, arsenic and sulphur compounds more readily than most reagents. Bromine and bromine water have already been proposed for the extraction of the precious metals, both for manufacturing and analytical purposes. The author found the analytical method given by Fresenius to be very troublesome. He finally devised the following process:—1. Brominating the burnt pyrites with bromine water containing excess of bromine. 2. Removal of the excess of bromine by means of free ammonia. 3. Solution of the resulting silver bromide by means of concentrated ammonium chloride solution. 4. Precipitation of the silver (and other dissolved metals) by means of zinc. 5. Estimation of the silver in the precipitate.

1. *Operation.*—An iron dish, with acid-proof lining, 30cm. diameter, receives 300—500grms. of the burnt pyrites, which passes through a sieve of 0.25mm. meshes. The powder is well covered with water, and bromine is added with constant stirring, care being taken to have excess of bromine finally. After allowing to stand for 24 hours, the mass is heated for an hour on the water-bath with constant stirring, supersaturated with ammonia, and after the addition of 500grms. ammonium chloride with a litre of water, is boiled for an hour and filtered. The residue is returned to the dish, without washing, and dried, then ignited in a Hessian crucible, and boiled again with ammoniacal ammonium chloride solution. After ignition the residue can be easily washed, and is now quite free from silver. If the burnt pyrites contained 5 per cent. of copper, this will be reduced to less than 0.1 per cent. in the residue, and as the copper is as difficult to extract with bromine as the silver, the removal of the copper indicates the removal of

the silver also, and it may be assumed in practice that the process is satisfactory as soon as the copper is reduced to 0.1 per cent. The silver solution obtained, about 4 litres in volume, is perfectly stable in the light, so that no darkening of the laboratory is necessary. The liquid is acidified with hydrochloric acid, warmed on a sand-bath, and the silver is precipitated by means of chemically pure zinc. After 1 to 2 hours, all is precipitated (in the presence of cobalt the solution becomes red) and the solution does not turn blue on adding ammonia. After careful decantation, the precipitate is washed with dilute hydrochloric acid, and finally with hot water. It contains frequently small amounts of chlorine and bromine compounds, and a little iron oxide which has passed the filter previously. This precipitate is heated in a clay crucible, with a little potassium cyanide, to reduce chlorides and bromides, then borax-glass is added, and the temperature raised to fuse the copper. The button so obtained is dissolved in nitric acid, and the silver is precipitated by means of a few drops of hydrochloric acid, and weighed.

In pyrites, the silver is estimated by first carefully roasting, and then proceeding as above. The method also gives good results in the case of roasted copper schists, and spathose iron ore containing fall ore and pyrites. The process can be completed in three days.

—J. T.

New Methods for Distinguishing Artificially-coloured Red Wines. Joseph Herz. Chem. Zeit. 10, 968—9.

THE following is the method employed for examining the colouring matter of wines in the Würzburg Laboratory:—30—50cc. of the wine to be tested are mixed in a porcelain dish with about 20—30cc. of a saturated solution of magnesium sulphate and 10—20cc. sodium hydrate solution added with constant stirring; all natural and artificial colouring matters, with the exception of the sulphonic acids, are thrown down with the magnesium hydroxide. A small quantity of the liquid is filtered off, and if the filtrate is not colourless, or only slightly yellow, further quantities of magnesium sulphate and sodium hydrate are added. Concentrated solutions are used in order to avoid too great dilution of the liquid. If very small quantities have to be tested for it is necessary to take 100cc. or more of wine, and evaporate down to 30cc. on the water-bath before adding magnesium sulphate.

The colourless filtrate is decomposed with excess of dilute sulphuric acid (1:3), which restores the red colour if sulphonic acids are present. *Acid magenta (rosaniline sulphonic acid)* is the most commonly used member of this group, and gives a violet-red colour with sulphuric acid; 1mg. per litre can be detected in 30cc. wine. If *orselle* colours have been also used in colouring the wine, the filtrate is blue, and becomes litmus-red on addition of acid. In this case it is necessary to test for acid magenta by Blarez' method (this Journal, 1886, 178) by treatment with lead dioxide, which destroys the orselle and natural colouring matters. The author cannot recommend Cazeneuve's method (this Journal, 1886, 178) for the same purpose.

In order to test the magnesium hydroxide for other colouring matters, the precipitate is stirred into hot water, roughly separated by decantation, then drained on a filter-pump, mixed with sand and dried on a water-bath. Extraction of the residue with ether separates ordinary magenta and "cassissin." The former is recognised by giving the well-known colour on evaporation of the ether; the latter yields a yellowish-brown residue and dyes wool a reddish-brown. With strong hydrochloric acid the wool becomes yellow, with ammonia colourless.

The alkaline filtrate obtained on treating the magnesium hydroxide precipitate with hot water as above, is coloured yellowish-brown by pure wine or wine coloured by whortle berries, dark-violet by *orselle*, red by *paucau*, light-red to dark-yellow by *cassissin*, yellowed to yellow-brown by *vinicoline bordeaux*; the last gives a violet zone by contact with sulphuric acid. The aqueous filtrate shaken with amyl-alcohol gives a red

residue with *ponceau*, dark-brown with *vinicoline*, unchanged with reagents, whilst with *cassissin* it is dirty-green with a violet edge, and is changed to yellowish-brown with hydrochloric acid. The magnesium hydroxide is dark-grey with pure wine, or wine coloured with vegetable colours; with *orseille*, violet; *magenta* or *acid magenta*, dirty-white; *cassissin*, dirty yellowish-brown; *vinicoline*, crimson-red.

Wine shaken with amyl-alcohol, and the coloured layer evaporated in a porcelain dish, gives a residue which is coloured by:—

		With Conc. H_2SO_4	With Conc. HCl	With NaHO
Orseille	Violet-red	Blue	Red	Blue
Bordeaux B	Carmine	Carmine	Carmine	Carmine
Ponceau RRR	Dark-red	Crimson	Crimson	Brown
Cassissin	Violet-purple	Yellow	Yellowish-brown	Red
Vinicoline Bordelaise	Cherry-red	Brown	Red	Brown

The author points out the great difficulty there is in distinguishing between the natural colouring matters, and especially between the natural colouring substance of the grape and that of whortle berries, and he now uses tartar-emetic as a reagent for these colouring substances. This substance is not only a test for artificially-coloured white wine, but also for red wine to which colouring matters have been added. The test is carried out as follows: 10–15cc. of the wine to be tested is shaken in a small cylinder with about 5cc. of a concentrated solution of tartar emetic, and then examined by transmitted and reflected light. If no change of colour takes place, the cylinder is placed on one side for some time, when a coloured precipitate separates out. Pure red wine from different sources always gives a cherry-red colour, whilst all other red vegetable colouring matters give varying shades of violet.

The colours given with tartar-emetic by—

Red wine pure is	Cherry-red.
Red poppy (Papav. Rhoeas)	Dark cherry-red.
Cherry	Violet.
Elder colouring matter (Sambucus) commerc.	Reddish-violet.
Whortle berry (Vaccin. Myrtill)	Bluish-violet.
Privet berries	Pure violet.

With red wine mixed with 10 per cent. foreign colouring matter, these colours are less intense, but by long standing and comparison with pure red wine they can be determined with certainty. The tartar-emetic appears to form an antimony-lake with the colours.—G. H. M.

On the Detection of an Artificial Colour in Claret.

Samelson. Chem. Zeit. 10, 998.

A SURE METHOD for detecting any artificial colouring in claret does not exist up to the present. The following may, however, lead to it. A test-tube filled three-quarters full with wine, to which an aqueous sodium nitrite solution is added, gives the following reactions with different wines: 1. White wine grows a little darker, but the liquid remains clear. 2. Red wine gives a precipitate, which settles after some time. The supernatant liquor must be yellow or yellowish-brown. Artificially coloured wines do not show that yellow colour. 3. A mixture of white and red wine gives a precipitate, which is inversely proportional with the addition of white wine. 4. White wines coloured red with a vegetable dyestuff—the decoction of bilberries, mallow, orchil and red poppy were especially examined—give no precipitate. If genuine clarets be mixed with white wines coloured red, the following may be noticed on adding sodium nitrite: 1. If bilberries or mallow are present, the supernatant liquor is violet; if orchil is present, the liquor is cherry-red; if red poppy be used, the supernatant liquor is light-red. The addition of cider to white wine can also be detected by sodium nitrite, cider being coloured dark-brown by that reagent, and yielding a small precipitate after some time.—S. H.

Remarks on Detecting Artificially-coloured Clarets.

J. Herz. Chem. Zeit. 10, 998.

AMBUHL and ELSNER employ a hot solution of tartar-emetic for testing the red colour of claret. The author finds that this reagent acts a great deal better in the cold.—S. H.

Tannin Estimation.

H. Dieudonné. Chem. Zeit. 10, 1067.

WHEN carefully followed, the author's method gives accurate results. It merely consists in taking the

density of the tannin solution, by means of a sensitive hydrometer, before and after treatment with skin-powder. A special hydrometer is employed, showing only one degree Baumé, but this one degree is divided into hundredths. The density observation is carefully made at a temperature of 22° C., and distilled water must be used in preparing the solution. As standard, the tannin of gall-nuts must be taken. The following table shows the gradation at 22° C. of 0.1–10grms. tannin dissolved in a half litre of water, the readings being given to the nearest half centesimal degree:—

Tannin.	Cent.	Tannin.	Cent.
Grms.	Baumé.	Grms.	Baumé.
0.1	1½	5.1	56
0.2	3	5.2	57
0.3	4½	5.3	58
0.4	6	5.4	59
0.5	7½	5.5	60
0.6	9	5.6	61
0.7	10½	5.7	62
0.8	11½	5.8	63
0.9	12½	5.9	64
1.0	13½	6.0	65
1.1	15	6.1	66
1.2	16	6.2	67
1.3	17	6.3	68
1.4	18	6.4	69
1.5	19½	6.5	70
1.6	20½	6.6	71
1.7	21½	6.7	72
1.8	22½	6.8	73
1.9	23½	6.9	74
2.0	25	7.0	75
2.1	26	7.1	76
2.2	27	7.2	77
2.3	28	7.3	78
2.4	29	7.4	79
2.5	30	7.5	80
2.6	31	7.6	81
2.7	32	7.7	82
2.8	33	7.8	83
2.9	34	7.9	84
3.0	35	8.0	85
3.1	36	8.1	86
3.2	37	8.2	87
3.3	38	8.3	88
3.4	39	8.4	89
3.5	40	8.5	90
3.6	41	8.6	91
3.7	42	8.7	92
3.8	43	8.8	93
3.9	44	8.9	94
4.0	45	9.0	95
4.1	46	9.1	96
4.2	47	9.2	97
4.3	48	9.3	98
4.4	49	9.4	99
4.5	50	9.5	100
4.6	51	9.6	101
4.7	52	9.7	102
4.8	53	9.8	103
4.9	54	9.9	104
5.0	55	10.0	105

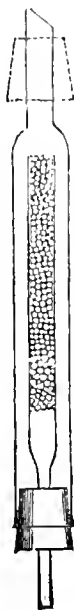
The process is thus conducted:—Of the sample to be tested, 20grms. are boiled four times with water and pressed; the liquid is made up to half litre, and if of a higher density than 1° Baumé must be diluted to that

density or lower, note being taken of the amount of dilution. 100grms. of the solution are frequently shaken with 5grms. of powdered skin, and next day filtered off and pressed. If 95° be the reading before, and 43° after treatment with skin, the difference (52°) corresponds to 4·7grms. of tannin according to the table, and if there were no dilution of the original half litre, this would consequently indicate 23·5 per cent. of tannin. To get a good reading of the hydrometer, the stem may be smeared with fat oil and well wiped. Dried skin should be used, as the amount of water retained by the undried would introduce appreciable error, as can be easily shown by direct experiment. Further, the thermometer, and especially the hydrometer, must be very carefully made.

—J. T.

The Determination of Nitrogen by Kjeldahl's Method. A. Rindell and F. Hannin. *Zeits. Anal. Chem.* 25, 155—156.

IN the *Zeits. Anal. Chem.* 24, 388 (see this Journal, 1886, 180), Pfeiffer and Lehmann recommended the use of a tube with a perforated platinum cone surmounted by glass beads, in order to retain small quantities of sodium hydrate, which are liable to be thrown up from the distillation flask. The authors have examined this improvement, and find that even when it is used small quantities of soda are still carried over by rapid distillation, owing to the beads becoming wet with condensed water, and, in consequence, spitting taking place. A greater length of beads did not rectify this, and it was found necessary to employ relatively dry beads, by



surrounding the bead-tube with a steam-jacket. The form of tube used is shown in the accompanying figure. The outer tube has a diameter of 25mm., and the inner tube with beads, which is closed at the bottom by a wire-gauze (nickel), is 10—12mm. wide. The column of beads should be at least 8cm. high. This tube was tested by the distillation of sodium hydrate and zinc, as in a nitrogen determination, and proved quite satisfactory. The authors use a much more dilute standard acid (1cc. $\text{H}_2\text{SO}_4 = 0.0006862\text{grm. N}$) than Pfeiffer and Lehmann, and consider this necessary with the small amount of substance employed. Litmus, by treatment with lime, according to Schlösing's method, furnishes an extremely good indicator.—G. H. M.

Estimation of Alumina in Aluminates. E. B. *Zeits. Anal. Chem.* 25, 183—186.

THE author has used for about three years the method described by Bayer (*Zeits. Anal. Chem.* 24, 542; this

Journal, 1886, 41), for the determination of alumina. The solution employed must be very dilute, and not contain more than 0·1 per cent. alumina. The alkalinity has been determined by adding an excess of ammonium salt, distilling, and determining the ammonia in the distillate.—G. H. M.

New Books.

FORTSCHRITTE UND VERBESSERUNGEN DER WOLLEN-STUCKFÄRBEREI. Seit 1877. Ein Praktisches Hilfs- und Lehrbuch für Färberei-techniker, Tuch-, Flanell-, Plüsch-, Filz- und Wollwarenfabrikanten und solche die es werden wollen. Unter Mitwirkung mehrerer Freunde herausgegeben. Von E. H. ANGARYD, Färberei-dirigent. Mit gegen 120 Farbmustern. Leipzig: Verlag von Gustav Weigel. London: H. Grevel & Co., 33, King Street, Covent Garden.

THIS is an 8vo volume, in the usual loose paper cover. Price 15s. It contains Preface, Introduction, and Table of Contents, with 206 pages of subject matter, and a Remark in Conclusion. With the text are interspersed about 120 specimens and dyed samples. The technical names of the colours are maintained throughout, and no reference is made to scientific nomenclature or formulæ; the book is clearly designed, however, for practical dyers. The arrangement of the subject is gathered from the following arrangement of the contents:—The tar colours and their use in general; (1) thoroughly fast dyes; (2) fast dyes; and (3) half-fast dyes. The technical nomenclature of the tar colours. The investigation of the tar colours occurring in the trade. The method of woollen piece dyeing with the tar colours. The use of the alizarin colours of gallein and cœrulein in the woollen piece dyeing (with 11 dye-patterns). Scarlet- and ponceau-red dyes (with 5 patterns). Orange dyes (with 3 patterns). Rose-coloured dyes (with 6 patterns). Carmine- and amaranth-red dyes (with 6 patterns). Bordeaux- and madder-red dyes (with 9 patterns). Yellow dyes (with 6 patterns). Green dyes (with 3 patterns). Olive-green dyes. Blue dyes (with 10 patterns). Violet dyes (with 5 patterns). Brown dyes (with 10 patterns). Black dyes. Fashionable dyes (with 33 patterns). On the usual mordants employed in dyeing with aniline colours alone or in combination with the natural colours. The washing of dyed woollen cloth. The removal of spots and stains from cloth. New materials for vat dyeing, proved by practice. Table for dyeing with tar colours, silks, wool, and cotton. Table for the detection of some tar colours by means of sulphuric acid. The greatest difficulties of the piece dyer; or, the errors that may be incurred in dyeing woollen piece goods. The loss of dye ("bleeding") in the case of dyed goods or washing and mangling, with reasons, together with hints for avoiding such accidents.

DIE FORTSCHRITTE DER LOSEN WOLLEN- UND WOLLENGARN-FÄRBEREI (unecht und walkecht). Seit 1881. Von R. SACHSE, E. H. ANGARYD und E. HARZANGER. Mit 39 Farbproben auf 5 Tafeln, deren Farbtöne mit den gegebenen Vorschriften übereinstimmen. Leipzig: Verlag von Gustav Weigel, 1886. London: H. Grevel & Co., 33, King Street, Covent Garden.

8vo-SIZED VOLUME, or rather pamphlet, containing Introduction and 99 pages of subject matter, and two pages of tables showing the maximum temperatures for dyeing goods (1) with certain coal-tar colours, and (2) with certain natural colours, and giving the percentage weights, etc., of mordants to be used. The

price of the work is 9s. 6d. The following treatment of the subject is adopted:—The washing of the loose wool. The washing of fine yarn, such as combed yarn. The dyeing of the yarns and loose wool generally. Bleaching by means of peroxide of hydrogen. Then follow methods of dyeing all the different colours, and recipes for the purpose. Fashionable dyes. Dyeing with alizarin colours that are fast against light and washing, on woollen yarn, combed yarn, and loose wool. Rinsing and drying of dyed yarns. Technical nomenclature of the tar colours. The patented dyeing system and apparatus of Obermaier; for wool, for spun yarn in cops, and for loose cotton. Different tested recipes for the woad and carbonate of soda vats.

DIE PRAXIS DER BLEICHEREI UND APPRETUR. Baumwolle, Leinen, Jute im Rohzustande, sowie als Garn, Zwirn und Gewebe. Von R. CENTNER. (Mit 4 Bleichmustern.) Leipzig: Verlag von Gustav Weigel, 1886. London: H. Grevel & Co., 33, King Street, Covent Garden.

SMALL 8VO PAMPHLET containing Preface, Table of Contents, and 123 pages of subject matter, and four pages of tabulated matter. Price 3s. 6d. The contents are headed as follows:—Bleaching process for linen or flax yarns. Practical process for bleaching with potassium and sodium permanganates. Practical introduction to the bleaching of vegetable fibres by means of chlorine and potassium permanganate (with 4 patterns). Bleaching with chlorine in the dry way. The bleaching of cotton yarn and cotton piece goods, especially in the small way. The modern style of bleaching and blue-dyeing of cotton yarn, of hosiery, and of cotton wool, as also of goods with Turkey-red stripes. Good method of bleaching for linen threads, sewing cottons, and worsteds. The bleaching of cotton yarns for the cotton-dyer. The bleaching of cotton wool. The bleaching of cotton fabrics for the calico-printer. Bleaching under the ordinary pressure. Bleaching under high pressure. The finishing of moleskin goods. The bleaching and finishing of English curtains in original width. The principles of the Mather-Thompson bleaching process. Improvement in the bleaching of vegetable fibres with chloride of lime, by G. Lunge. On bleach-spots, by Georges Witz. On the best method of bleaching jute fibres. On the bleaching of jute by means of sulphur. The finishing of cotton fabrics. Finishing of blue printed goods, etc.

Monthly Patent List.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

11973 A. Budenberg, Manchester—From Schäffer and Budenberg, Germany. Improvements in pressure gauges. September 21
12014 R. J. Friswell and A. Myall, London. Improvements in filter presses. September 21
12018 A. M. Clark, London—From V. A. Pillond, France. Apparatus for automatically compressing air. September 21
12077 J. R. Alsing, London. Improvements in the construction of titrating cylinders. Complete specification. September 22
12078 H. H. Lake, London—From C. Bianchi, Italy. Improvements relating to means for promoting combustion in boiler and other furnaces. September 22
12091 C. A. Clapham, Bradford. Improvements in filters. September 23

12108 C. A. Knight, Glasgow. Improvements in sectional steam generators. Complete specification. September 23
12166 H. J. Allison, London—From J. Richards, United States. Improvements in centrifugal pumps. September 24
12182 R. N. Boyd, London. Improvements in safety and signal apparatus for steam boilers. September 25
12196 L. Gienre and E. Ofstedahl, Newcastle-on-Tyne. Improved apparatus for accelerating the generation of steam in boilers during and after firing. September 25
12282 E. S. T. Kennedy, London. Flame deflectors upright boilers. Complete specification. September 28
12301 P. Fanta, A. Cohen, and E. Cohen, London. Improvements in the construction or arrangement of parts of furnaces. September 28
12347 G. Harding, Preston. A steam or water valve that does not require any packing. September 29
12352 J. L. Wade, Glasgow. An improved composition for preventing incrustation in steam boilers. September 29
12371 H. Lane and R. H. Taunton, London. Improvements in the manufacture of metallic vessels, suitable for containing gases and volatile liquids under pressure, and for other useful purposes. September 29
12381 J. Gilmore, J. F. Gilmore, and W. R. Clark, London. Improvements in steam generating apparatus. September 29
12410 J. S. Booth, London. Improvements in the construction of boiler and other furnaces. September 30
12412 W. P. Hoblyn, St. Columb. Improvements in smoke consuming stoves and furnaces. Complete specification. September 30
12418 G. Best, London. Improvements in apparatus for condensing steam. September 30
12419 A. L. Normandy, London. Improvements in machinery for producing distilled water from sea or other impure water. September 30
12426 G. Downing, London. From E. Brouillet, France. An improved safety apparatus for steam generators. September 30
12467 R. Thompson, Liverpool. Improvements in or appertaining to furnaces in which the materials operated upon are mechanically stirred under heat. October 1
12475 J. Y. Johnson, London—From L. Labeyrie, France. An automatic valve for steam or other pipes, or conduits conveying fluids under pressure. October 1
12498 J. Brookbanks, Newcastle-on-Tyne. Composition for removing scale or other incrustations from the inside or other parts of steam boilers. October 2
12508 J. Turns, South Shields. An improved apparatus for purifying the feed-water of steam boilers. October 2
12526 W. G. Little and C. W. G. Little, Rotherham. Supplying steam boilers automatically with water, and regulating the height of the water. October 5
12546 W. Shaw and J. Cran, Glasgow. Improvements in apparatus for increasing the draught in boiler furnaces, and funnels or chimneys. October 5
12724 J. T. Key, Sheffield. Improvements in apparatus for supplying tar and other liquid fuel to furnaces and other like fires. October 6
12758 A. Black, jun., London. Improvements in water softening apparatus, applicable also for clearing or clarifying other liquids. October 6
12774 T. F. Hind and R. Lund, London. Improvements in machinery or apparatus for grinding paints, inks, starch, chocolate, and other like materials. October 7
12808 F. W. Hart, London. Improvements in gas fires, stoves, or furnaces for chemical, domestic, and manufacturing uses. October 8
12867 J. W. Lovibond, Salisbury. Improvements in apparatus for standardising and measuring intensity of colour in transparent bodies. October 9
12944 A. A. Joy, London. Improvements in and connected with gauges for indicating and controlling the pressure of gas. October 11
12975 F. H. Stacey and H. Wilkinson, Sheffield. Improvements in apparatus for blowing exhausting, and pumping. October 12
12986 H. C. F. Stoimer, London. Improvements in the construction of apparatus for washing and absorbing gases, and for evaporating or concentrating liquors. Complete specification. October 12
13015 A. Brin and L. Q. Brin, London. Improvements in means and apparatus for effecting the heating of water or liquids for raising steam, or for other purposes. October 12
13012 G. L. Scott, Manchester. Improvements in filters. October 13
13133 H. H. Lake, London—From S. Jönsson, Denmark. Improvements relating to regulating mechanism for use in connection with intermediate belt gear, chiefly designed for limiting the speed of centrifugal apparatus. Complete specification. October 14
13310 J. Murrie, Glasgow. Improvements in boilers for generating steam and other vapours. October 19
13336 A. J. Boulit, London—From W. A. O. Hegeman, United States. Improvements in fluid pressure regulators. Complete specification. October 19
13341 W. Anderson, London. Improvements in centrifugal pumps. October 19
13417 E. Kemp, Glasgow. Improvements in compound boilers or apparatus for heating water and generating steam. October 21
13441 W. P. Thompson, Liverpool—From A. J. McBride, United States. Improved filtering and cooling apparatus. October 21

COMPLETE SPECIFICATIONS ACCEPTED.*

1885.

- 12484 A. Brio. Refractory material for lining furnaces, capable of withstanding high temperatures. October 8
 14115 G. A. Greeven. Pumps for raising and forcing liquids. October 5
 14547 P. Don and A. Don. Apparatus for transforming force into direct rotation, also applicable for forcing liquids or gases. September 28
 14901 R. Matthews. Apparatus for compressing air, etc. October 5
 15420 W. L. Wise—From V. Popp. Apparatus for production and distribution of compressed air. October 12
 15470 C. Blagburn. Apparatus for burning liquid fuel in furnaces. October 15
 15472 J. C. Williams-Ellis. Apparatus for generating steam and heated gases. October 15
 15513 J. Lyle. Pressure-reducing valves. October 12
 15713 S. H. Johnson and C. C. Hutchinson. Subsidence apparatus. October 22

1886.

- 9787 P. D. Bywater and M. J. Bywater. Tap for filtering and purifying liquids. October 15
 9911 C. Otto. Working furnaces by compressed air. Oct. 5
 10552 W. R. Lake—From J. Evans and D. H. Burrell. Centrifugal apparatus for separating liquids of different densities. October 12
 11383 J. L. Peslin. Smoke-consuming furnace. October 8
 11711 J. E. Brown. Means for consuming smoke in boiler furnaces. October 15
 13379 F. M. Wheeler. Surface condensers. October 15
 11896 W. H. Beck. Refrigerating apparatus. October 19

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

- 12266 W. Boggett, London. Improvements in obtaining heat and light, and in the apparatus employed therewith. September 27
 12340 A. G. Meeze, Redhill. Improvements in apparatus for the manufacture of gas from fluid hydrocarbons. Sept. 29
 12522 E. Harrison and T. Chilton, London. Improvements in gas fittings or appliances for increasing the illuminating power of gas from burners. October 2
 12649 D. G. Martens, London. Improvements in the manufacture of self-extinguishing candles. October 5
 12722 J. A. Walker, London. An improved means of mixing dried air with petroleum, and apparatus therefor, for lighting buildings, ships, and towns, the same being applicable for lighting stoves. October 6
 12801 H. Kenyon, Manchester. Improvements in the production of heating and illuminating gases, ammonia, and other products. October 8
 12907 A. Brin and L. Q. Brin, London. Improvements in means and apparatus for the obtaining of heat for generating steam or for other purpose. October 9
 12955 C. R. F. Schloesser and R. P. Schloesser, Manchester. An improvement in the construction of gas taps. October 12
 13109 J. E. Lewis, London. Improvements in regenerative gas lamps. October 14
 13153 J. Williams, Liverpool. The utilisation of the waste steam of engines. October 15
 13163 H. C. Christopher, London. Improvements in methods of and apparatus for obtaining heat and light. October 15
 13214 P. Innes, Glasgow—From J. Bremner, Peru. Improvements in hydraulic mains—apparatus used in the manufacture of illuminating gas. October 16
 13227 W. H. Hawkes, London. Improved compound for treating coal and other fuel. Complete specification. Oct. 16
 13299 F. W. Hayward, Norwich. Improvements in artificial light. October 19

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 13108 J. Y. Johnson—From C. Dubois. Extracting sulphur from materials employed in the purification of gas, or other materials containing sulphur. September 28
 13360 C. Hunt. Ascension pipes used in the manufacture of gas. September 28
 13990 J. G. Penn. Manufacture of compound fuel. Oct. 1
 15706 E. Blass. Water gas apparatus for distillation of the fresh fuel. October 22
 15768 A. M. Clark—From J. S. Leng. Manufacturing illuminating gas. October 5
 15780 H. H. Lake—From H. K. Flagler. Utilisation of fuel in a comminuted condition, and apparatus therefor. Oct. 22
 15822 J. R. Wigbam. Illumination of lighthouses. Oct. 22

1886.

- 6511 F. W. Clark. Apparatus for manufacture of gas for illuminating and heating purposes. October 8

- 9867 J. T. King—From C. Voss. Extracting paraffin from petroleum distillate. September 21
 11829 P. M. Justice—From A. P. Rockwell. Carburetting compounds. October 19

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, ETC.

APPLICATION.

- 12769 W. Burns, Leith. "A cumulative piston retort." Improvements in the construction of retorts and apparatus for the destruction and cumulative distillation, carbonising, and calcining of dry compound substances. October 7

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

- 12022 A. Kern, London. Improvements relating to substances chiefly designed for use in the preparation of colouring matters, and to the manufacture of colouring matters therefrom. September 21
 12551 R. Ripley, Liverpool. Improvements in or relating to forming blacklead, blue, and other like substances into packets. September 22
 12908 G. Pitt, London—From L. Cassella & Co., Germany. The manufacture of naphthol and naphthylamine-monosulphonic acids, and of dyestuffs therefrom. October 9
 13086 F. R. Japp, Chiswick. The manufacture of dyes. October 11
 13466 C. A. Bennett, London. The manufacture or production of colouring compounds or materials. October 21
 13473 C. A. Bennett, London. The treatment of certain colouring compounds or materials for the purpose of rendering them soluble or more soluble, and suitable for dyeing and printing. October 21

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 15337 H. Hassencamp and The Farbenfabriken vorm. Bayer & Co. Colouring matters for dyeing and printing. October 12
 15716 Dr. C. Rudolph and Dr. O. Gurke. Manufacture of colouring matters. October 12

1886.

- 10434 J. C. Jefferson—From G. A. Dahl. Manufacturing blue dyestuffs and colouring matters, and method of fixing the same. October 8
 11356 O. Imray—From H. M. Baker. Manufacture of a resorcin blue. October 8

V.—TEXTILES: COTTON, WOOL, SILK, ETC.

APPLICATIONS.

- 12212 T. S. Brigg, Leeds. An improved printed coating or cloth. September 25
 12213 T. S. Brigg, Leeds. An improved cloth. September 25
 12319 H. E. Newton, London—From O. Chemin, France. Improvements in the treatment of raw or manufactured animal fibres for the purpose of separating vegetable matters therefrom. September 28
 12710 T. Pickles, Manchester. Improvements in the treatment or preparation of grey or unbleached cotton or linen warps or warp yarns prior to weaving. October 6
 13051 T. Honeywood, London. Improvements in the preparation of fibre for textile and other purposes. October 13
 13429 J. A. Hart and Dr. C. Baynes, London. Improvements in machines for blowing and beating cotton or other textile materials. October 11

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 11892 H. J. Haddan—From J. Breuer. Decorticating ramio and other textiles, and apparatus therefor. October 8
 13380 F. Sutcliffe. Apparatus for treating cotton, wool, etc., in process of manufacture. September 21
 13782 T. Pickles. Treatment of grey or unbleached warps or yarns prior to weaving. October 12
 15070 J. McNaught and W. McNaught. Machinery for drying wool, etc., and separating foreign matters therefrom. October 19
 15313 C. Till. Improved fabric suitable for the manufacture of blankets, mattresses, wearing apparel, etc., and apparatus for its production. October 12
 15717 W. R. Lake—From F. E. J. Dubar. An improved textile fabric. October 1

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

- 11981 A. Hodgkinson, Ballyclare. Cleansing composition for linen or cotton fabrics or yarns, for use in the process of bleaching same. September 21

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

- 12216 J. Kirkpatrick. See Class XI.
 12286 J. Worrall, Dukinfield. Sewing together the ends of calico or other fabrics intended for calendering, bleaching, and other purposes. September 28.
 12312 J. Hildesheim and The Patent Decorative Washable Sanitary and Waterproof Paper Company, by L. H. Watson, London. Improvements in machinery for sizing or varnishing and applying colours to paper and other fabrics. September 28.
 12362 F. A. Gatty, Manchester. Improvements in dyeing cotton, cotton yarns, and cotton fabrics. October 20.

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 11810 W. E. Akroyd and W. W. L. Lishman. Apparatus for dyeing and sizing warps. October 1.
 11975 A. S. Young. Printing on calico, etc. October 19.
 15438 G. Watson, jun. Obtaining baths of chloride of antimony for use in dyeing and calico printing. October 12.

1886.

- 38 B. F. Cresson. Dyeing and printing aniline black, and solutions used therefor. October 12.
 7083 T. R. Shillito—From The Zittauer Maschinenfabrik and Elsengeesserei (früher A. Kiester & Co.). Apparatus for oxidising aniline black on woven fabrics. October 15.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

- 12070 A. Brin and L. Q. Brin. See Class X.
 12110 J. J. Hood and A. G. Salaam, London. Improvements in the manufacture of meta-stannic acid, and in the purification of meta-stannic acid. September 23.
 12255 T. Raynaud, Greenwich. Producing hyposulphite of soda, for antichlor, photography, etc. Complete specification. September 27.
 12480 F. H. Gossage, T. T. Mathieson, and J. Hawliczek, London. Improvements in and apparatus for the treatment of sulphide of sodium for the manufacture of sulphide of sodium therefrom (*sic*). October 1.
 13001 J. I. Watts and W. A. Richards, Liverpool. A new or improved sodium product and method or methods of manufacturing the same. October 12.
 13173 A. Packard, London. Improvements in the fabrication of compounds of bisulphate and biphosphate of the alkalis from the neutralised sulphates and concentrated phosphoric acid. October 15.
 13236 A. Frank, London. Improvements relating to the treatment of the spent lyes used in the manufacture of cellulose, by means of sulphites, for the recovery of sulphurous acid therefrom, and to the utilisation of the said lyes after such treatment. October 18.
 13389 E. Solvay, London. A new or improved continuous furnace for the production of chlorine. October 20.

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 12035 G. G. Pickling, W. Hopkins, J. Dore and J. Dore, London. Manufacture of vinegar. September 24.
 13099 J. G. Chapman and R. Foote. Apparatus for generating carbonic acid gas. October 12.
 13108 J. G. Johnson. From C. Dubois. See Class II.
 13162 J. B. Spence. Manufacture of sulphide of zinc. September 28.
 11279 G. H. Bolton and J. Leathwood. Lids applicable to caustic soda drum heads, etc. October 3.
 14361 E. W. Parnell and J. Simpson. Production of sulphur and sulphuric acid. October 19.
 15386 N. M. Henderson. Apparatus for distilling ammonia. October 5.

1886.

- 46 E. W. Parnell and J. Simpson. Production of pure carbonic acid gas. October 15.
 715 W. B. Giles and A. Shearer. Manufacture of phosphoric acid. October 22.
 10798 H. J. P. Sprengel. Production of sulphuric acid. October 5.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

- 12076 T. Cooper J. Thomas, London. Improvements in the manufacture of glass. September 22.
 12148 E. H. Pearce and H. Besson, Birmingham. Improvements in machinery for working glasses. September 24.
 12388 F. D. Bradley and H. Snow, Longport. An improvement in the method of piercing or perforating pottery, porcelain, etc. September 29.
 12196 W. Horn and R. Bell, Sunderland. Improved shears used in the manufacture of glass bottles. October 2.
 12542 E. R. Blundstone. See Class IX.
 12793 H. L. Boulton and W. P. Rix, London. Improvements in the production of ornamental pottery ware. October 7.
 12868 W. Breffit, London. Improvements in the manufacture of glass bottles and other like vessels or utensils. October 9.

- 12990 J. Armstrong, London. Improvements in the manufacture of glass, opal, crystal, porcelain, and like substances, and machinery and appliances therefor. October 12.

- 13132 E. Moore, London. Improvements in rockers for use in connection with the annealing hear, or hear, of a flint glass house. Complete specification. October 11.
 13209 W. Lutwyche, London—From A. Ceresa, Italy. Producing mosaic by means of enamelling substances and coloured glass. October 16.
 13233 J. G. Macintyre and F. Vodrey, London. Improvements in the method of decorating ceramic ware. October 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 13561 F. D. Bradley and H. Snow. Manufacture of ornamental pottery, porcelain and glass. October 12.
 13392. L. J. Murray. Manufacture of glass-ware. October 22.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

- 12421 W. D. Curzon, C. R. Williams, and the Patent Paving and Construction Co., Limited, London. An improved manufacture of cementitious slabs and the like for structural and other purposes. September 30.
 12470 E. Long, London. Improvements in concrete blocks for building purposes, and in the means or apparatus employed for manufacturing them. October 1.
 12542 E. R. Blundstone, London. Improvements in the manufacture of plaster of Paris. October 2.
 13242 F. W. Floring and K. J. Meyer, Barmen, Germany. Improvements in making fireproof ceilings, partition walls, and complete buildings; applicable also for making tubes, etc. October 18.
 13278 C. Straub, London. An improved composition or building material for architectural purposes. October 18.
 13291 H. H. S. Pearce, London. Improvements in structural appliances and other fittings, formed by a combination of ordinary building materials with indiarubber and other elastic substances. October 19.
 13306 R. G. Scrivener, Newcastle, Staff. Brick and tile facing. October 19.

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 13328 T. Smith. Combination of materials for making cements, etc. October 22.
 15751 W. Joy. Charging cement kilns. October 22.

1886.

- 10631 J. Mobberley and H. Perry. Manufacture of bricks. October 12.
 11027 J. Sutherland. Construction and ornamentation of walls, ceilings, etc. October 12.

X.—METALLURGY, MINING, ETC.

APPLICATIONS.

- 11971 J. Park, Glasgow. Improvements in recovering tin from tinned plate and other materials. September 21.
 11972 B. H. Thwaite, Liverpool. The purification of iron ores and fluid iron metal, and apparatus therefor. September 21.
 12053 D. McKechnie, Liverpool. Improvements in or relating to furnaces for the smelting or refining of copper. September 22.
 12055 M. Vesenmayer, London. Improvements in the method of collecting finely-divided gold and float gold, and in apparatus therefor.
 12070 L. Brin and L. Q. Brin, London. Improvements in the treatment of copper and iron pyrites for the manufacture therefrom of sulphuric acid and oxides of copper and iron, and in the treatment of the said oxides for the production therefrom of metallic copper and the higher oxides of iron. September 22.
 12117 W. Maxwell. See Class XVIII.
 12128 R. Poole, Handsworth. An improved "annealing cover" for sheet-iron or other purposes. September 21.
 12147 J. Ridge, Sheffield. An improved metallic composition or alloy. September 24.
 12157 J. Dale, London. Improvements in tinned copper goods. September 24.
 12202 J. Whitley, Leeds. Improvements in the construction of bronze guns and other ordnance. Complete specification. September 25.
 12227 W. Fairclough and W. Warburton, Manchester. Improvements in reflecting appliances for use in miners' safety lamps. September 27.
 12249 W. S. Squire and S. C. C. Currie, London. Obtaining zinc in a metallic form from alkaline solutions of zinc oxide. September 27.
 12271 W. H. Fallett, London. Improvements in plant for casting steel ingots. Complete specification. September 27.
 12295 G. J. Atkins, London. New or improved means and apparatus for the separation of gold and other metals from their ores. September 28.

- 12326 H. H. Lake, London.—From J. Illingworth, United States. Improvements in moulds chiefly designed for use in the manufacture of armour plates. Complete specification. September 28.
- 12355 A. Brin and L. Q. Brin, London. Improvements in the manufacture of iron and steel. September 29.
- 12364 C. J. Sandahl, J. Birchall and J. Musson, Liverpool. Improvements in the manufacture of iron and steel. September 29.
- 12362 C. J. Sandahl, J. Birchall and J. Musson. Improvements in the manufacture of iron and steel, and in blast furnaces employed therein. September 29.
- 12363 C. J. Sandahl, J. Birchall and J. Musson. Improvements in and in connection with the manufacture of iron and steel, partly applicable to other purposes. September 29.
- 12428 E. R. Cummins, London.—From G. P. Schweder, Portugal. Improved process for extracting gold and antimony-regulus from auriferous antimony ore. September 30.
- 12487 G. A. Goodwin and W. F. How, London. Improvements in the method of and process for utilising tin plate waste. October 1.
- 12541 R. Miller and N. E. McCallum, Glasgow. Improvements in furnaces for the manufacture of steel. Complete specification. October 2.
- 12559 H. Kellerman, London. Improvements in the manufacture of pipes or tubes of sheet metal. October 2.
- 12592 A. N. Hopkins, London. Improved means for restoring the surface of "raised" articles of tin plate. October 4.
- 12623 M. Settle, Manchester. Improvements in electric safety lamps for use in mines. October 5.
- 12630 W. S. Squire and S. C. Cuthbert, London. Obtaining metallic zinc from its ores. October 5.
- 12636 B. J. B. Mills, London.—From N. W. Perry, United States. Improvements in detectors for marsh gas and other hydrocarbon gases. Complete specification. October 5.
- 12651 J. W. Swan, London. Improvements in electric safety lamps, and in the means of detecting and measuring fire-damp or explosive gases. October 5.
- 12675 W. D. Allen, London. Improvements in machinery or apparatus for forging by hydraulic pressure. October 5.
- 12684 A. Gutensohn and J. W. Bushe, London. Improvements in metallic alloys. October 5.
- 12692 H. W. Bessemer, London. Improvements in the manufacture of malleable iron and steel, and in apparatus employed for that purpose. October 5.
- 12720 C. Hensler, London. Improvements in producing silicious copper, and utilising the same for metallurgical purposes. October 6.
- 12727 C. Blagburn, London. Improvements in apparatus for pumping water from mines. October 6.
- 12729 G. M. Edwards, London. Improvements in machinery and appliances for treating, dressing, and cleaning tin and other mineral ores, and in modes, means, and processes connected therewith, and for other useful purposes. October 6.
- 12835 A. T. D. Berrington, London. The manufacture of certain alloys of iron. October 8.
- 12861 J. Warick, Newcastle-on-Tyne. Improvements in the treatment of fume in lead works. October 9.
- 12866 J. Gilchrist and D. Ballardie, Glasgow. Improvements in miners' lamps. October 9.
- 13073 A. Parkes, London. Improvements in extracting gold, silver, and other metals from ores or compounds containing the same. October 13.
- 13151 F. Siemens and J. G. Gardon, London. An improvement in the manufacture of steel. October 15.
- 13162 E. Packard, London.—From E. C. Griffin, United States. Improvements in machinery for pulverising ores or other hard substances. Complete specification. October 15.
- 13185 G. Baron de Overbeck, London. Improvements in the manufacture of aluminium. October 15.
- 13189 H. J. Kirkman, London. Improvements in the process of cleansing metals or alloys previous to their being coated with other metals or alloys. October 15.
- 13223 S. Godfrey, London. Improvements in machinery or apparatus for drilling or boring hard substances, such as rock or stone, for blasting and other purposes. October 16.
- 13230 J. B. Clark and The Panther Lead Company, Limited, London. Improvements in smelting lead ores. October 16.
- 13238 J. Ravenhand, Sheffield. Improvements in ingot moulds, consisting of interchangeable and replaceable projections for nicking ingots to facilitate topping or breaking the ingot. The projections to be fitted in dovetailed recesses and triangular holes through the sides of the mould. Oct. 18.
- 13239 G. H. Lloyd, Sutton Coldfield; A. L. Lloyd, Leamington; and H. Bewlay, Mosley. Improvements in pipes of malleable metal and their mode of manufacture. October 18.
- 13266 E. Walsh, Jun., London. Improvements in blast furnaces. Complete specification. October 18.
- 13476 R. H. W. Biggs, London.—From C. Malin, Paris. Extracting industrially the tin from the iron in tin scraps. October 20.
- 13460 K. Heathfield, London. Improvements in apparatus used for coating sheets of iron and steel and articles of iron and steel with zinc or alloys of zinc or other coating metal or alloy. October 21.
- 13628 J. A. Crane. Production of iron and steel tubes. October 12.
- 14426 G. F. Simonds, London. Manufacturing rolled metal articles, and apparatus therefor. September 24.
- 15170 J. D. Grey. Rolling steel and iron bars or plates for the manufacture of tin orterne plates. October 12.
- 15215 T. Brown and J. G. Gordon. Machinery for rolling steel and iron. October 8.

1886.

918 A. Bobrownicki. Treatment of phosphoretic slag. October 5.

1827 G. A. Goodwin and W. F. How. Foundry ladles and crucibles. October 5.

3138 G. T. Lewis. Smelting tin ore and recovering tin from tinned sheet-iron scraps. October 15.

10011 H. H. Lake.—From R. de Montgelas. Manufacture of chloride of aluminium and double chloride of aluminium and sodium. September 28.

10013 H. H. Lake.—From R. de Montgelas. Apparatus for manufacture of chloride of aluminium and double chloride of aluminium and sodium. October 1.

10306 H. Tabor. Making foundry moulds. October 8.

10607 W. R. Lake.—From R. de Montgelas. The electro-deposition of aluminium. September 24.

11385 F. E. Hainley. Utilising the expansion and contraction of metals due to changes of temperature. October 12.

XI.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

12216 J. Kirkpatrick, Glasgow. Improvements in the manufacture of oil for Turkey-red dyeing, calico printing and such like purposes. September 25.

12652 A. Brin and L. Q. Brin, London. Improvements in the oxidation of oils for use in the manufacture of paints or varnishes, or for other purposes to which oxidised oils are applicable. October 5.

12709 C. Schill and C. Seilacher, London. A new or improved process for oxidising oils and fats and other organic substances. October 7.

13387 R. B. Tennant, Glasgow. Improvements in and connected with the refining or purifying of mineral and other oils, and in the recovery of by-products therefrom. Oct. 20.

13402 G. Linget J. Viaudely, London. Improvements relating to the manufacture of soap. October 20.

COMPLETE SPECIFICATION ACCEPTED.

1885.

14957 C. D. Abel.—From The Fabrik Chemischer Produkte Actien Gesellschaft. Separation and treatment of fatty matter from compounds containing wool-fat. October 5.

XII.—PAINTS, VARNISHES, AND RESINS.

APPLICATIONS.

12499 J. B. Hannay, Glasgow. Improvements in preservative coatings for ships' bottoms. October 2.

12632 A. Brin and L. Q. Brin. See Class XI.

12712 W. R. Hodgkinson and A. Wingham, London. Improvements in the treatment of amber and other like fossil gums in the manufacture of varnish, or for other use. October 6.

13284 F. M. Lyte, London. Improvements in the manufacture of pigments. October 18.

13416 J. B. Hannay, Glasgow. Improvements in the manufacture and treatment of lead pigments and compounds, and in apparatus therefor; in part applicable for condensing or collecting various fumes or similar matters. October 21.

COMPLETE SPECIFICATION ACCEPTED.

1886.

606 C. F. Rousset. A new varnish, and method of applying the same. September 21.

XIII.—TANNING, LEATHER, GLUE AND SIZE.

APPLICATIONS.

12681 E. P. Nesbit, London. A process for clearing hides, skins, hair, wool or fur from lime. October 5.

13283 A. M. Clark, London. From J. B. West, United States. Improvements in tanning and stuffing leather. October 18.

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

11111 E. Edwards.—From C. Kollico, Cornelle. Process and apparatus for tanning leather. September 21.

1886.

5344 J. W. Vaughn. Machines for putting and otherwise treating hides and skins. September 24.

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

12140 K. Küpper. Process and compound for welding cast or wrought steel in bars, and for regenerating the welded steel. October 8.

12981 N. de Bernardos and S. Olzewski. See Class XVIII.

XIV.—AGRICULTURE, MANURES, ETC.

APPLICATIONS.

- 12772 W. S. Squire, London. Obtaining manure from distillers' spent wash. October 7
 13170 C. D. Abel, London. From P. Coupry, France. Improvements in the treatment of fecal matter for conversion into manure, and in apparatus therefor. October 21

COMPLETE SPECIFICATION ACCEPTED.

1886.

- 11883 J. H. Barry. Treatment of excreta and sewage sludge for production of manure. October 19

XV.—SUGAR, GUMS, STARCHES, ETC.

APPLICATIONS.

- 12012 H. H. Lake, London. From T. F. Krajewski, United States. Improvements relating to the treatment of sugar cane for the extraction of sugar therefrom, and to apparatus therefor. September 21
 12302 A. M. Wood, London. Improvements in the manufacture of indiarubber, gutta-percha, and analogous gums. September 28.
 12520 E. M. Knight, Halifax. Improvements in the manufacture of liquid gum. October 2
 12535 A. Brin and L. Q. Brin, London. Improvements in the manufacture of sugar. October 2
 13128 F. Swales, London. From H. Swales, Brazil. Improvements in sugar-cane mills. October 14
 13168 E. M. Knight and A. H. Hobson, Halifax. Improvements in the manufacture of liquid cement or gum. October 15
 13337 W. Ryder, London. Manufacturing "Ryder's silicated rubber composition." October 19

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 15897 M. P. W. Boulton, B. E. R. Newlands and E. Perrett. Revivifying spent charcoal.

1886.

- 3116 M. F. Heddle, D. C. Glen and D. Stewart. Filtering and decolourising sugar, syrups, etc., and preparing material therefor. October 5
 5735 J. Guardiola. Evaporating apparatus for saccharine juices. September 28

XVI.—BREWING, WINES, SPIRITS, ETC.

APPLICATIONS.

- 12071 F. Foster, London. Supplying the gasometer of continuous action liquid aerating machines automatically from a reservoir of compressed or liquefied carbonic acid gas. September 22
 12291 E. Manbré, Liverpool. Improvements in or appertaining to compounds applicable for the manufacture therefrom of ale, stout, porter, lager, and other like liquors, and in apparatus for making said compounds. September 28
 12560 H. Stockheim, London. Improvements in apparatus for preventing the formation of froth upon beer when introducing the same into casks, and for similar purposes. Oct. 2
 12611 F. A. Reihlen, London. Improvements relating to the preparation and bottling of carbonated beverages, and to apparatus therefor. October 4
 13222 A. W. Gilman, S. Spencer, E. S. Spencer, and A. Perry, London. Improvements in the preparation of brown or black malt or colouring material for use in brewing, and in apparatus employed therein. October 16
 13276 A. G. Fraser and G. Epstein, London. Improvements in treating worts in separating yeast therefrom, and in treating yeast. October 18
 13385 H. Grote, London. A process for removing fusel oil and other impurities from crude spirits, or from the wash containing crude spirits. October 20

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 12036 G. G. Picking, W. Hopkins, J. Dore and J. Dore, Bromley. Manufacture of spirits. September 28
 14868 T. P. Chittenden. Aerating and attenuating worts and other liquors, and securing a pure germless atmosphere wherein to carry on fermentation. October 5
 15063 A. W. Gillman and S. Spencer. Finings for sour beer, waste and returns. October 8
 15168 F. Keeling. Preparation of finings for beers and wine. September 28

1886.

- 6069 S. A. W. Howmann. Manufacturing compressed yeast. September 21

- 9258 F. Faulkner and W. Adlam. Appliance for use in circulating and aerating malt and raw grain worts when producing ordinary malt liquors, distillers' wash, etc. October 8

- 10376 D. W. Hamper and J. H. Howell. Improvements in brewers' coppers and analogous vessels. October 5

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, ETC.

APPLICATIONS.

A.—CHEMISTRY OF FOODS.

- 11995 W. G. Dunn, London. Improvements in baking powders. September 21
 11999 L. von Wohlforth, A. Tausky and F. von Friedland, London. Improvements in means and apparatus for preserving meat. September 21
 12061 H. R. Lipscombe, London. Manufacture of a composition for softening and purifying water. September 22
 12155 G. Fry, London. An improved apparatus for introducing cold air into refrigerating chambers. September 24
 12156 G. Fry, London. An improved apparatus for thawing frozen meat, or for the refrigeration of animal and vegetable substances. September 24
 12292 E. Phillips, Croydon, and R. Stavely, London. Manufacturing dull coffee finings. September 28
 12408 P. Homero, London. A tea made of a plant, herba homeriana, which is a cure for consumption and other diseases of the chest. September 30
 12608 J. Low, London. Improved mode of preparing food from cereals. October 4
 12890 J. Low, London. Improved mode of preparing food from cereals. October 9
 12951 A. Brin and L. Q. Brin, London. The manufacture of nitrogenated water. October 12

B.—SANITARY CHEMISTRY.

- 12075 G. H. Leane, London. Improvements in apparatus for the continuous or intermittent filtration of sewage, and for like purposes. Complete specification. September 22
 12218 T. Ogden, London. Improvements in furnaces for the desiccation, deodorisation, and combustion of animal and vegetable matters or town's refuse. September 27
 12259 R. de Soldenhoff, London. Improvements in the desiccation, incineration, and carbonisation of precipitates or solids resulting from sludge or other substances liable to putrefy, and in means and apparatus employed therein. September 27
 12882 W. B. Hallett, London. Improvements in the preparation of materials for use in the treatment of sewage and other liquids in order to purify them, and in the method of treating them, and in apparatus for use in their treatment. Sept. 29
 12829 G. W. Brenner, London. Preparing ingredients for treating sewage and other liquids for their purification. October 8
 12850 F. P. Perkins, Exeter. The treatment of sewage by clarification and precipitation. October 9
 13007 J. C. Butterfield and H. H. Mason, London. Improvements in the treatment of sewage and the recovery of valuable products therefrom. October 12
 13313 R. H. Reeves, London. Improvements in the construction of and arrangement of apparatus for the ventilation of drains or sewers, the deodorising of sewage, and disinfecting of gases. October 19

COMPLETE SPECIFICATIONS ACCEPTED.

A.—CHEMISTRY OF FOODS.

1885.

- 14552 B. H. Thwaite. Preserving animal and vegetable foods and liquids. October 22.
 14697 H. Pischow. Apparatus and process for preserving alimentary substances. September 28
 14807 W. F. B. Massey—From Mainwaring and J. Edmunds. Arrangements for oxygenating water contaminated with organic matter. October 5
 15387 J. Hooker. Preservation of condensed milk, and of milk, condensed or not, in admixture with alimental or medicinal matters. October 15
 15399 V. Tribouillet and E. Husson. Preservation of alimentary substances, and apparatus therefor. October 19.
 16071 F. Schmidt. Apparatus for the manufacture of ice. September 28

1886.

- 10170 H. J. Haddan—From M. Blumenthal. Manufacture of rennet. September 28
 10995 H. P. Madsen. Utilising the blood from slaughter houses in preparing food for man and cattle. October 12

B.—SANITARY CHEMISTRY.

1885.

- 13749 W. C. Sillar and The Native Guano Co. Treatment of sewage and other liquid putrescent matters. September 24
 15102 J. A. Drake and K. Muirhead. Means and appliances connected with the separation of liquids from sewage in filter-presses. October 13

1886.

- 11883 J. H. Barry. See Class XIV.

XVIII.—ELECTRO-CHEMISTRY.

APPLICATIONS.

- 11997 W. Maxwell London. A method of producing carbon fibres or filaments. September 21
 12001 E. W. Adcock and J. W. Trotman, London. Improvements in primary batteries. September 21
 12111 J. Noad, London. An improved galvanic battery for generating and storing electricity. September 23
 12117 W. Maxwell, London. An electric furnace. Sept. 23
 12165 W. Stanley, jun., London. An improved electric generator. September 24
 12169 G. C. Fricker, Putney. Improvements in dynamo-electric machines. Complete specification. September 24
 12235 G. F. Rose, London. Improvements in primary electric batteries. September 27
 12251 G. Binswanger and C. Pollak, London. Improvements in electric batteries. September 27
 12531 H. Weymersch and R. McKenzie, London. Improvements in primary electric batteries. October 2
 12595 E. Andreoli, London. Improvements in secondary batteries. October 4
 12632 J. W. V. Kent, London. A new method of transmitting and distributing electro-magnetic energy. October 5
 12656 A. J. Boulton, London—From H. B. Cox, United States. Improvements in or relating to batteries. Complete specification. October 5
 12756 R. Dick and R. Kennedy, Glasgow. Improvements in and connected with the transformation and distribution of electric energy, and in apparatus therefor. October 6
 12770 W. Munns, London—From H. Merzbach and S. O. Eisele, Germany. Improvements in galvanic batteries. October 7
 12778 S. F. Walker, Cardiff. Improvements in dynamo-electric machinery or apparatus for generating electric currents by means of motive power, and for converting electrical energy into motive power. October 7
 12818 W. W. Beaumont, London. Secondary batteries. October 8
 12861 W. H. Munns, London—From H. Merzbach and T. O. Eisele, Germany. Improvements in dynamo-electric machines. October 9
 12880 R. E. B. Crompton, London. Improvements in armatures of dynamo-electrical machinery and electrical motors. October 9
 13080 W. C. Goldner, London. A novel material for the production of an exciting and depolarising battery fluid. October 13
 13208 E. T. Carter, Bristol. An improved electricity meter. October 16
 13366 J. R. H. Williamson, Manchester. Improvements in the method of and apparatus for transmitting motion to the armatures of electro-motors, and for analogous purposes. October 20
 13419 W. H. Scott and E. A. Paris, London. Improvements in conductors for armatures of dynamo-machines. October 21
 13451 J. Roper, Bradford. A cap or cover for the ends of the revolving armatures of dynamo-electric machines. Complete specification. October 21
 13459 H. J. Huddan, London—From F. V. Y. Graells, Spain. An improved apparatus for regulating automatically the intensity of the currents in dynamo-electric machines. Complete specification. October 21

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 12081 J. Hopkinson and E. Hopkinson. Dynamo-electric machines. October 8
 12096 C. J. Bosanquet, W. Cameron, and W. A. Tamlinson, Lincoln. Appliances for regulating the force of electric currents. September 28
 12984 N. de Bernardos and S. Olszewski. Method and apparatus for working metals and metalloids by direct application of electric currents. October 8
 13697 J. G. Johnson—From T. Farbaky and S. Schenck. Secondary batteries. September 28
 13741 E. J. Houghton. Apparatus for regulating or intercepting the current from dynamos. September 28
 14383 J. T. Armstrong. Elements for electrical batteries. September 24
 14386 G. J. Atkins. Electric and storage battery. October 8
 15105 J. A. Kendall. Cells for generating electricity by means of hydrogen. October 12
 15231 J. Blenkinsop. An insulating medium for protecting submerged surfaces of iron and steel from the electro-galvanic action set up between such plates and constituents of anti-fouling compositions. October 15
 15255 B. Pell. Improved manganese voltaic batteries. October 12

1886.

- 308 J. T. Armstrong. Supplying liquids and mixtures to batteries. September 24

- 10824 J. T. Armstrong. Electrical batteries, and method and materials for working the same. September 24
 11823 P. Bailly. Primary and secondary batteries. October 19

XIX.—PAPER, PASTEBOARD, ETC.

APPLICATIONS.

- 12013 C. J. Singleton, London. The manufacture of cigarette paper from the fibre of stalks of tobacco leaves and the stems of tobacco plants. September 21
 12217 R. D. Sinclair and J. G. Brown, Glasgow. Improvements in the manufacture of paper, to render same antiseptic and germ proof. September 25
 12477 H. Gardner, London—From J. Scherbel and T. Remus, Germany. Apparatus for scoring paste, straw, card, and like boards for boxes and cases. October 1
 12781 T. Routledge, London—From A. Abadie, France. Improvements in mills for triturating and refining materials for paper making or for other purposes. October 7
 12900 H. Gardner, London—From J. Scherbel and T. Remus, Germany. Apparatus for scoring paste, straw, card, and like boards for boxes and cases. October 9

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

- 795 C. Crookes. Rag-engine bottom plates used in the manufacture of paper. October 1
 10811 C. Russell and P. H. Cragin. Paper pulp screens. September 21

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

APPLICATIONS.

- 12082 J. Allpass, Manchester. A substitute for quinine and other alkaloids and their salts for medicinal purposes. September 23
 12532 J. H. Wilson, London. The mechanical and chemical treatment and preparation of the plant botanically termed *Bauhinia Vahl.* October 2
 12610 P. H. Lecornu and A. Raynaud, London. Improvements relating to the manufacture of perfumery. October 4

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 14001 A. G. Brooks—From T. S. Nowell. Manufacture of lactic acid and lactates. October 8

1886.

- 596 C. Fahlberg and A. List. New compounds of organic alkaloids and saccharine, and method of producing them. October 15
 10280 J. G. Johnson—From F. von Heyden. Process for the manufacture of oxychinoline carbonates. October 1

XXI.—EXPLOSIVES, MATCHES, ETC.

APPLICATIONS.

- 12561 H. T. Maxim, London. Improvements in the manufacture of cartridges and explosive projectiles. October 2
 12741 G. J. Smith, London. A method and material for rendering the coating of fuses incombustible. October 6
 13011 O. Imray, London—From G. M. Mowbray, United States. A process and apparatus for the manufacture of pyroxyline. Complete specification. October 12
 13375 T. G. Hart, Bath. Improvements in explosives for use in firearms. October 20

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 13581 B. H. Remmers and J. Williamson. Manufacture of gunpowder. October 12
 13582 B. H. Remmers and J. Williamson. Manufacture of gunpowder, and treatment or preparation of carbonaceous materials therefor. October 12

THE JOURNAL OF THE Society of Chemical Industry:

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The supply of copies of the Journal for January, 1882, being now exhausted, the Secretary would be glad to receive communications from members possessing extra copies of that number, in good condition, with a view to purchase.

Should sufficient applications for complete sets be received, the number will be reprinted.

The number of Subscriptions at the old rate which are being received from members for the year 1887, renders it necessary to call attention to the fact that, under the provisions of the Bye-Laws, as revised at the last General Meeting, the Annual Subscription to the Society will be in future 25s., instead of One Guinea as heretofore.

Arrangements are being made whereby those who have given Orders on their Bankers may exchange them for Orders at the new rate. Meanwhile, members wishing to make payments in advance are earnestly requested to note the alteration, and thus save much correspondence.

Authors of communications read before the Society or any of its Local Sections are requested to take notice that, under Bye-Law 43, they cannot receive the prescribed 50 copies of their communications unless they comply with the condition laid down in that Bye-Law—viz., that they give notice of their desire to receive such copies upon their manuscript before sending it to the Editor. Mention should also be made as to whether the Discussion is to be included in the reprint.

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 Agnew Griffith, Daisy Mount, Blundell Sands, Liverpool, chemical student.
 Boston Harley, Laboratory, Carron Works, Falkirk, N.B., analyst.
 G. Crompton Holt, c/o Hugh Hughes, 4, York Buildings, Sweeting Street, Liverpool, analyst.
 J. Cecil Husband, Knowsley Street, and 21, Heywood Street, Cheetham, Manchester, pharmacist.
 William Morgan, Ph.D., Swansea, public analyst.
 T. Burdon Reay, 85, Herrington Street, Sunderland, chemist, Wear Fuel Works.
 James Riley, Laboratory, Brinscall Works, near Chorley, Lancashire, chemist.
 Jno. Taylor, The Belgrave Pharmacy, Torquay, chemist.
 Wm. Turnbull, 14, Wilbertorce Terrace, Gateshead-on-Tyne, manufacturing chemist.
 Thomas Wardle, Leek, Staffordshire, silk dyer, printer, and sericulturist.
 J. B. Wilkinson, Tong Street, Dudley Hill, Bradford, Yorks, chemical manufacturer.
 Jos. Wood, Brinscall, near Chorley, Lancashire, calico printer.

London Section.

CHEMICAL SOCIETY'S ROOMS, BURLINGTON HOUSE.

Chairman: David Howard.

Committee:

Sir F. A. Abel.	R. Messel.
H. F. Armstrong.	R. E. R. Newlands.
W. Lant Carpenter.	B. Redwood.
W. Crowder.	T. Royle.
C. Graham.	John Spiller.
S. Hall.	G. C. Frewby.
A. K. Huntington.	J. Williams.

Hon. Local Sec. and Treasurer: Thos. Tyrer,
 Garden Wharf, Church Road, Battersea, S.W.

The meetings of the London Section will be held on the first Monday in each month.

SESSION 1886-87.

Prospective Arrangements.

Dec. 6.—Mr. E. H. Truesdel, "On Strontium Hydrate."
 " Mr. T. Fairley, "On Various Forms of Filter Pumps and Water Jet Aspirators."
 " Messrs. A. G. Green and F. Evershed, "Note on the Volumetric Estimation of Nitrous Acid."
 Jan. 3.—Mr. Watson Smith, "On the Explosive, 'Kincite.'"
 Feb. 8.—Mr. W. Jago, "On Fermentation in its relation to Bread Making."

Notices of Meetings and Papers will be found in the Scientific Journals.

Notices of papers and communications to be made to the Local Secretary.

WHAT SHALL WE DO WITH OUR TAR?

BY LEWIS T. WRIGHT, C.E.

AMONG the various products of the distillation of coal in gas-works is a black, more or less viscid material known to us as tar. In some other manufactures tars are produced, but they are not discussed in the present paper.

This substance, that in the early history of gas undertakings was a waste product, became, through the discoveries of chemists and the enterprise of manufacturers, a storehouse of wealth and beauty. A few years ago, when the purchasing powers of the world for articles of necessity and luxury alike seemed to be almost without a limit, some of the products obtainable from coal-tar held a very considerable commercial value, and tar reached the price of 65s. per ton; yet, when the diminished demands of the purchasing populations first became evident to the great bulk of larger industries, tar products maintained their prices for a short time as though they were not to be affected as other commodities; but in a little while the channels through which so much had poured now began to evidence signs of choking, and increasing pressure became more and more necessary to get the products to flow away. Rapid then was the fall in prices—the irresistible force of which no efforts could stay.

The first individual to feel this enormous reduction of prices was the tar distiller; but the shadow cast over his shoulder by coming events fell across the threshold of the gas-maker, who suffered all the pangs of alarm before being actually smitten with the full blast of the storm, and then loud and indiscriminate, but quite unjust, complaints were hurled against tar distillers, dealers, and merchants, for what was thought to be their share in the fall of prices. When these were high and certain gas undertakings were receiving large sums for their tar and liquor, much injudicious jubilation was indulged in, and the inflated statements emanating from certain corners of the gas world became distorted and magnified images in the eyes of the public, who regarded gas-works as establishments wherein coal-gas was produced for nothing, and who firmly believed that the selling price of the gas was pure net profit. The enterprises called forth by the desire of capitalists to have a share in these streams of pure unalloyed profit did much to intensify, and even precipitate, the immense depression of gas products we are now so much deploring.

The quantity of tar annually produced in the United Kingdom must be a matter for estimation.

The returns made to the House of Commons relating to the authorised gas undertakings of the United Kingdom give the amount of coal carbonised in the year 1884 as 8,004,518 tons; and in 1883 as 7,631,304 tons. These show that the increased consumption of coal shown by the returns for 1884 over those for 1883 was 4·89 per cent. Assuming that the same percentage of increase obtained in the year

1885, we should have for the coals carbonised by authorised undertakings in that year the quantity of 8,395,940 tons. There are here and there scattered about the country small private works and unauthorised gas undertakings, but the amount of coal they consume in a year must be, as compared with the total, very nominal.

I take the total quantity of coal carbonised for gas-making purpose in the United Kingdom to be now 8,450,000 tons per annum.

For the purpose of arriving at the total quantity of tar produced by the distillation of the above quantity of coal, I shall take as the average yield throughout the United Kingdom the amount of 12.5 gallons of an average specific gravity of 1.185 per ton of coals carbonised. This will give the production of tar in 1885 as 105,625,000 gallons, or 558,780 tons weight. Of the tar produced in the distillation of coal only a certain (large) proportion goes into the hands of the tar distiller, for a certain (small) amount is used direct in the raw condition for tarring, asphalt, and other purposes. I find it very difficult to form an opinion of the extent of this tar thus escaping distillation. In some cases within my knowledge the proportion of local sales, as they are termed, reached 24 per cent., and that, too, when the price was at its highest point; but in view of what I know of the local sales in other towns, and from information generously supplied me by fourteen representative gas undertakings in all parts of the country, I take the quantity not distilled at $7\frac{1}{2}$ per cent. of the total production. There is also no doubt a certain quantity of tar now being employed for retort-firing, but at present I do not believe it much exceeds 1 per cent. This relatively insignificant proportion of tar in use as fuel is likely to be very much augmented if prices remain at their present level, or fall below it.

We may fairly assume that the total quantity of tar going into distillers' hands is 97,175,000 gallons. It would surprise many people if they were told that tar only contains about 5 per cent. of substances having positive value as materials entering into chemical manipulation, and that the great bulk goes for common purposes, such as creosoting, lubrication, and fuel.

Surely the day will arrive when the great bulk, instead of a select portion of the coal-tar hydrocarbons, will have positive chemical uses, and who can doubt but there are immense triumphs yet to be gained by our chemists and manufacturers in this direction?

I regret my inability at present to give definite information regarding two points of considerable interest—viz.: (1.) Variation in the composition of tars with varying qualities of coal distilled; and (2.) influence of temperature of production on the composition of the tar. Such results as I have are not sufficiently confirmed by repeated experiences to admit of publication; but, whilst touching upon this portion of the subject, it will be as well, perhaps, to give some broad information respecting the variation in the yield of tar from coal distilled at various temperatures, especially since G. E. Davis, in a paper read before this section on January 4, 1885, has published statements regarding the variation in the yield of tar that are opposed to my experience. As we increase the distillation temperature of our carbonising process we find the tar slightly decreasing in quantity, but increasing in specific gravity. I shall detail below the results of certain experiments made in this direction, but would now call attention to the fact that it is the tar which limits the distillation temperature we ordinarily employ in our retort-houses, probably more than any other cause. I believe that most large establishments would employ much higher heats than now, if it were not for the trouble

of stopped ascension-pipes and plugged-up hydraulic mains, etc. The moment when this difficulty of stopped pipes, etc., sets in is well-defined for each kind of coal. We know that when a certain yield of gas is being got from a certain coal, we are on a line that cannot be overstepped with the present disposition of gas-making plant. Now, it is all very well for Mr. Davis to call upon every gas-works in the country to reduce their make of tar 30 per cent. by an increase in the distillation temperature. If he were acquainted with the average gas-works he would know that there was very little margin for such an increase as to appreciably affect the production of tar at all.

The experiments given in table on page 560, conducted in clay retorts with the ordinary form of gas plant, will well serve to illustrate the variation in the volume and weight of tar yielded by coals distilled at widely different temperatures.

In the table the expression "normal temperature" means the best practically and continuously possible in a modern gas-works. By "very high temperature" is meant one only practicable by careful nursing, and for a short period.

It will be observed, by the inspection of the table, that with the coking coal differences of temperature represented by a reduction in the yield of gas per ton of 3272 and 3628 cubic feet affected the weight yield of tar 2.4 and 12.7 per cent. respectively, and that with the cannel coal a reduction in the yield of gas of 2727 cubic feet was represented by an increase in the tar of 8.7 per cent.

In the average gas-works the distillation temperature employed is as high as can be conveniently attained with the present forms of gas-making plant. So there is practically no margin for any reduction in the output of tar by the employment of higher "heats." There is, however, a tendency for the improvement of plant in this direction to admit of the employment of higher distillation temperatures.

The present extremely low price offered for tar, after a period of inflation, naturally induces those interested in gas manufacture to seek for some other more profitable means of utilising the tar than that of selling it to tar distillers, and various schemes, mostly *réchauffés*, have been submitted to the notice of gas engineers. These admit of the following classification:—

(a) Those dependent upon a preliminary distillation of the tar, and wherein the gas-works would be dependent on the services of the tar distiller.

- 1.—Utilisation of the lighter hydrocarbons (benzol) for the enrichment of coal gas.
- 2.—Utilisation of certain portions of the tar for manufacture of illuminating gas by their destructive distillation.

(b) Those wherein the tar is used by the gas maker, *en bloc*, without the intervention of the tar distiller.

- 1.—Utilisation of the tar for manufacture of illuminating gas by its destructive distillation.
- 2.—Utilisation of tar as fuel.

However hopeless some of these suggestions may appear to be on close investigation, we are yet bound to give them our attention, and if they serve no other purpose in the end than the promotion of inquiry, we ought, I suppose, to be grateful for that.

The only schemes that can be said to have had any hold at all upon the minds of gas engineers are those for the benzolisation of coal gas, and for the use of tar as a fuel. The idea of gas-making out of oil seems to be opposed to the gas engineer's instincts, so many absurd schemes having been brought out and failed in this connection.

The first scheme to consider is the benzolisation of coal gas, and can be very simply stated. Taking the

percentage by weight of benzol in coal tar as 0.8, the weight percentage of tar on the coal as 6.6, and the quantity of gas to be carburetted per ton of coals as 10,000 cubic feet, we have as the total quantity of coal-tar benzol available per 1000 cubic feet, 0.1183 lb. From laboratory experiment I find that to increase 16 to 17 candle gas a quantity of 19 lb. of benzol must be added to every 1000 cubic feet, so the amount of benzol available is only equal to an enrichment of our coal gas of 6-hundredths of a candle, and the cost, if we take benzol at 1s. 6d. per gallon will be at the rate of about $3\frac{3}{8}$ ths of a penny per candle per 1000 cubic feet enriched.

There is neither practical nor economical advantage here.

I have given some attention to the question of the conversion of the coal tar hydrocarbons into illuminating gas by destructive distillation. It must be remembered that all these bodies have been previously submitted to a high temperature, have been born in the gas retort, and are acclimated, as it were, to such conditions. As a matter of fact it is not easy to convert them into gas of any use.

The various oils I have worked with have been crude naphtha, light oil, and several fractions of creosote. The oil was run into a retort packed with

the great feature with these oils. How they could be got over in practice I cannot say.

Even the present price of crude naphtha, low as it may seem, quite precludes its use as a material for manufacture of illuminating gas. One of the drawbacks of the light and creosote oils was the poor quality of the gas, and even if the difficulties I have spoken of—viz., ubiquitous naphthaline obstructions—could be combated, there is nothing to invite their use for gas making at their present values.

Further, it must be remembered that gas-works are systems wherein the form of each piece of apparatus has been developed in the light of many years' experience for the best performance of its function in dealing with the particular coal and coal gas it is the object of the works to manufacture. I think it would be correct to say that many large gas-works of to day successfully dealing with one class of coal would be at a considerable difficulty if they were called upon to deal with coal of another type. Our gas-works are not designed to deal with gas from tar oils, and even if an apparent advantage could be shown with tar oils, one would hardly care to erect the necessary plant and work out its best form unless the advantage were felt to be of a permanent and not of a temporary

CLASS OF COAL.	Temperature of Distillation.	Cubic Feet of Gas per Ton.	Gallons of Tar per Ton.	Specific Gravity of Tar.	Tar per Ton. lbs.	Weight-percentage on Coal.
Derbyshire Blackshale (No. 1)	Very High	11,128	10.63	1.210	128.62	5.74
	Normal	10,400	—	1.185	—	—
	Very Low	7,856	11.50	1.145	131.67	5.88
Derbyshire Blackshale (No. 2)	Very High	11,150	12.01	1.207	114.96	6.47
	Normal	10,400	—	1.185	—	—
	Very Low	7,562	14.38	1.136	163.35	7.29
Notts. Top Hard Cannel	Normal	9,852	21.32	1.147	214.54	10.92
	Very Low	7,125	23.81	1.116	265.72	11.86

lumps of caustic lime, and the gas there generated passed through another similar retort also packed with lime in pieces. Both retorts were maintained at an orange-red heat. It will suffice here without entering into the details of each individual experiment, to broadly give the practical results obtained. The quantity and quality of the illuminating gases obtained in these trials depended upon the rate at which the oils were fed into the system of retorts.

Gas from Crude Naphtha.—The highest illuminating power obtained was 20½ candles with a yield of 10,130 cubic feet per ton. The highest yield of gas was 27,100 cubic feet per ton, with an illuminating power of 14½ candles; when the make of gas per ton fell as low as 6000 to 8000 cubic feet the illuminating power did not rise above 20 candles.

Gas from Light Oil.—In 16 experiments the make per ton ranged from 18,000 to 30,000 cubic feet per ton, and the illuminating power from 16 to 13½ candles.

Gas from Creosote Oil.—The highest illuminating power I obtained with creosote was 14 candles with a make of 13,300 cubic feet per ton; the highest yield of gas 29,300 cubic feet per ton, with an illuminating power of 8½ candles. To decompose the oils such a temperature has to be applied that low candle power gases are only obtained.

In all these experiments with tar oils continual stoppages took place from obstinate accumulations of dirty naphthaline in the pipes; chronic stoppages are

character. Not any of the schemes above discussed have the merit of dealing with the whole bulk of the tar.

It would be useless here to enter into the history of all the attempts that have been made to work up tar as a gas making material. Every gas maker has tried to make gas out of tar and failed. The obstructions with this material are even more obstinate than with the oils, and no one yet has been found who could deal with them. The results I have obtained with a pair of retorts charged with lumps of caustic lime average 10,700 cubic feet of 12½ candle gas. Tar as a gas-making material is, as every one is aware, dear at a gift.

I consider that it would be most disastrous to the gas industry, resting as it does upon a basis different to any other manufacture, having a monopoly of the supply of gas in return for certain parliamentary restrictions to be subjected to violent changes in its procedure at every change of the market of tar and tar products, disturbing its discipline and its efforts to perfect its processes, and interfering with the regularity of its services to the community. The gas consumer would be injured by the oscillating policies of the gas works, for with them it is not altogether a question of price. Excellence of management in regard to evenness of quality and perfect regularity of supply counts for something. In discussing this part of the question I do not wish it to be supposed that practical gas makers have lately seriously enter-

tained such schemes; on the contrary, I believe that, whilst they all like to know something about them they have not yet settled down to treat them *au sérieux*.

When, however, the engineer considers the question of liquid fuel, he is on pleasant ground, for what can exceed its simplicity and efficiency. Divest this subject of all commercial limitations and regard only the mechanical aspect, and one is charmed and delighted with the easiness of its management and the regularity and intensity of the heat obtained. So neat and perfect is the solution of this problem that the engineer might well wish that he could always have his fuel in the liquid condition.

My experiments with tar and creosote firing have taken many directions, and their application to retort and boiler furnaces has been specially studied.

Tar firing for retorts has been conducted mainly on the three following methods:—

1. Injection into the furnace by means of compressed air, with atomising apparatus.
2. Injection into the furnace by means of steam, with atomising apparatus.
3. Feeding into the furnaces by simple gravitation alone or in combination with coke.

In all the above cases the temperature arrived at was so intense (locally to the furnace) that only the most refractory of fire-bricks, such as the best Welsh silica bricks, could be found to withstand it. Furnaces lined with the best Stourbridge material would not last out 48 hours, whereas, in ordinary work with coke they would last over eight months' continuous firing. Even silica brick does not appear to last so long on tar as with coke, but I cannot speak with certainty on this point. Certainly, the temperature is so high that none but the finest fire material could be successfully employed.

The injection of tar by compressed air is, with regard to retort firing, a refinement. For metallurgical uses it would be of the highest value, as the resulting temperature is immense, but against steam injection in retort firing it is at a disadvantage. Steam injection has occupied many minds of late, but I am convinced that it could not hold its own against the simple feeding of tar into the furnaces by gravitation with special means provided to secure perfect combustion.

Experiments were conducted with a view of determining the relation between tar and other fuels, weight for weight, in a two-flued Lancashire boiler with Galloway tubes of the best modern construction.

The following table shows the pounds of water evaporated per pound of the respective fuels employed:—

Class of Fuel.	Water evaporated per pound of Fuel.
Nottinghamshire top hard cannel	7.40
Yorkshire silkstone coal	8.42
Derbyshire silkstone coal	8.11
Coke from top hard cannel	8.34
Coke from Derbyshire silkstone coal	9.49
Unscreened breeze from silkstone coal	6.44
Tar, steam injected	10.70
Creosote	11.24

The relation in these boiler trials between tar and silkstone coke is as 1 to 1.13. In the case of retort firing the relation between steam injected tar and coke is as 1 to 1.17, and in the case of gravitation feeding as 1 to 1.24.

The gravitation system of tar firing only requires the manipulation of one valve per furnace and possesses the further advantage over the steam injection system of an economy of fuel of 6 per cent., and the cost for apparatus is less. With it the per-

fection of combustion and freedom from smoke leave nothing to be desired. No advantage was found to result from a combined system of coke and tar firing. The action on the furnaces when the tar used was at the rate of about 12 gallons of tar per ton of coals carbonised by the furnace was just as severe as with the other systems.

With suitably lined furnaces there is no difficulty of any importance connected with tar firing, whilst there are some mechanical advantages, such as the saving of the labour attendant upon the charging and cleaning of fires that would amount to from 3d. to 4d. per ton of coals carbonised. In a London stage retort-house, the cost of firing amounts to 3½d. per ton of coals carbonised, and there are works wherein the cost is nearly 5d. per ton.

In studying the question of the price at which it would pay to burn tar, each individual case would have to be dealt with on its merits, since circumstances widely differ with the locality. For instance, there are places where the substitution of tar for coke as fuel would simply place upon the market a coke of excellent quality, fetching 15s. per ton; whereas, in another works, the coke pushed out would be useless for sale, and would command nothing, perhaps not even fetching the price of its removal. If it be desired to know the fuel value of tar per gallon at any place, the following formula may be employed:—Let T = cwt. of tar made per ton of coals carbonised; f = the fuel equivalent in cwt. of coke of 1 cwt. of tar—viz., 1.24; S = saving in wages per ton of coals carbonised; p = selling price of coke per cwt.; g = gallons of tar produced per ton of coals carbonised; F = fuel price of tar per gallon:—

$$\therefore F = \frac{Tfp + S}{g}$$

In London coke may be taken as worth 12s. 6d. per ton net at the works, and the quantity of tar produced per ton of coals carbonised at 1.16 cwt.—viz., 10.75 gallons of a specific gravity of 1.21—equal as a fuel to 1.44 cwt. of coke, and if we concede a saving in labour connected with firing of 3d. per ton of coals carbonised, the fuel value of tar will be (assuming that the price of 12s. 6d. per ton of coke would be maintained in the face of the increased output of coke) 1½ths of a penny per gallon.

In a case where the coke pushed out by tar firing would be worth 1d. per cwt. only, and the production of tar is 1.37 cwt. per ton of coals carbonised—viz., 13 gallons of 1.185 sp. gr., and when a saving of 4d. per ton of coals carbonised might be expected in the labour of firing, the fuel price of tar would be 0.438 of a penny per gallon.

It would appear that tar is at less than fuel price in most places now, and the reason that so little is being burned is to be explained by a natural mental inertia. I think a great many people would like to avoid the contingency if they could, and some perhaps are fearful of the effect upon an already glutted coke market.

If all the tar in the country were burned, the present quantity of gas coke sold, which is presumably 3,168,750 tons, if we consider the coke sold to average 7.5 cwt. per ton of coals carbonised, would be increased by nearly 700,000 tons, an amount that could not be put upon the coke market without serious consequences arising, but such a circumstance as the burning of all the tar could not possibly occur, for the withdrawal of a certain portion would certainly cause the price of tar to rise.

That there has been an over-production of tar, or that the price has been regulated by any other causes than the laws of supply and effective demand, I do not believe. There is no evidence

of serious accumulation of stocks of tar or tar products. All seem to be absorbed in their proper markets. Should it not be a source of gratification to us that in this severe commercial crisis the industries, acting as intermediaries between tar makers and consumers of the finally manufactured forms of tar products, have been able to find purchasers for their articles? There are no signs of an extinction of the uses of these things, and when the present rage of competition passes away, there is every reason to believe that the manufactures in question will again become profitable to all concerned. In order to arrive at a decision, whether or not to burn tar, a gas undertaking can only be influenced by plain business considerations of its economy or otherwise as a fuel. To burn it out of pique, because a certain price cannot be realised for it, or with the idea of forcing up the price by restricting the market, is unworthy of a public body.

I must express my entire dissent from Mr. Livesey's views, as given in the *Journal of Gas Lighting* for March 2, 1886. I feel that the course he advises us to take of burning 30 per cent. of our tar, with the intention of forcing up the price of the remainder to 2d. per gallon, is one that would bring us into discredit with the public, who have a decided objection to trade combinations and monopolies. We have the monopoly of gas supply, and at least we can be content to let the tar and other products be controlled by the natural courses of trade.

If the tar is worth more as a fuel than it will fetch by sale, then it will be proper to burn it; but if it can sell for more than it is worth as a fuel, then it will be bad business not to sell. Interference on the part of the gas industry with the idea of a convention or trade combination for the purpose of fictitiously forcing up the price to arbitrary limits, is to be strongly reprobated, and would certainly have injurious consequences from the crippling and checking of the development of the industries that radiate from the gas works. These things are always better left alone. We have, with regard to the future, every interest in keeping these industries alive, and it is quite possible, that by clumsy interference, we might give some industry such a blow as it could not recover from, and we should finally be sufferers by its extinction.

I am quite sure, however, that there is no need to anticipate that any injudicious tampering with trade will be indulged in. We can safely leave the question to be solved by the clear judgment of our gas makers—the tar producers.

DISCUSSION.

The CHAIRMAN said that the best thanks of the meeting were due to Mr. Wright for his very clear exposition of a practical question. In practical chemistry the question to be solved invariably came to this—was the process *profitably* applicable? There were many processes which were exceedingly beautiful, and even perfect, in theory, which were extravagant beyond words in actual working. They must not be carried away by the enthusiasm of those who would teach them that everything had its value, and that all that was required was science to render that value available. In dealing with gas-tar, however, one must consider the whole bearing of the question, and not merely one side of it. He hoped that some of these gentlemen present who had had practical experience in the matter would now give the meeting the benefit of their views and experiences.

Mr. FRANK LIVESEY (South Metropolitan Gas Co.) was a little disappointed, considering the title of the paper, that Mr. Wright had not given the meeting a somewhat better and fuller answer to the question

involved in it. He had told the meeting what he had done in the way of burning gas as fuel, but the support he gave to that method of dealing with it was by no means hearty. He had told them also of some of the difficulties to be met with, but not how to get over them. One of those difficulties, they were told, was the intense local heat produced in the furnace, and destructive of all materials save the very best Welsh fire-bricks. That experience did not correspond with his own. If tar were injected into a furnace, issuing just under the furnace arch, that arch having a few small nostril holes in it, no doubt the arch would soon be melted down. But if the tar were injected into a deep furnace of the regenerative type, local heat would be kept down, only those portions of the brickwork which were closely laid one on another would be affected, and very little damage would be done. He had seen tar fuel injected by steam, by gravitation, and by various other methods, and knew from actual practice that a furnace would stand tar firing as long as ordinary firing. He heartily agreed that a combination of coke and tar fuel was not advantageous. He would like, in conclusion, to correct Mr. Wright with respect to the construction he had put upon Mr. George Livesey's letter to the *Journal of Gas Lighting*. His brother was the last man who would advocate a trade combination. But here was a residual product which must increase with the continually increasing consumption of gas. As the makers could not combine to restrict the production of tar, they must find some method of disposing of it. At present the only known way was to burn it; and anyone who should suggest an effectual and economical method of doing so, would greatly benefit the gas manufacturers.

Mr. N. H. HUMPHREYS (of Salisbury) could quite endorse Mr. Livesey's statements respecting the burning of tar in furnaces of ordinary fire-brick. He had a furnace which had been in use for five months, and which he found to be in better order than if he had used coke in it. He had used the tar fuel without steam,—simply running it in by gravitation. He had been very particular as to regulating the quantity of tar admitted, and also as to the temperature. He had not had uniform good luck with tar fuel, having once melted a retort down in 48 hours. That misfortune was due to want of attention to the damper. With proper attention, one could have a fire of almost any temperature. It was necessary to maintain a good full-red heat and a sufficient air supply, or the chimney would smoke. At Salisbury gas-works, they were using up all their surplus tar as fuel, as the price obtained for the tar would not pay for its carriage. Moreover, they could obtain a good price for their coke.

Mr. H. E. JONES (Commercial Gas Co.) said that those who knew Mr. Wright knew him to be scientifically competent to sooner or later obtain from gas-tar higher service than that which it could render merely as a fuel, and that he would bring to bear upon the question that commercial instinct which would teach him how best to apply his science. He was glad that Mr. Livesey's motives in recommending an increased combustion of tar had been thoroughly explained. There was also an impression existing that, owing to the rise in the value of tar products some time ago, coke burners had been endeavouring to recover their liquid products, and so there had been introduced into the market a tar supply from a new source; hence the present over-production. The depression in the price of tar would, he believed, eventually lead to many more chemical works being put up in this country for the manufacture of the higher classes of tar products. It seemed barbarous to burn tar at all, it being the source of so great a number of useful products. He knew a contractor

who was using tar largely for paving, and who claimed to have produced a material superior even to French asphalt. As the source of products of the carbo-hydrogen series there was great scope for the profitable use of tar; and he had hoped that Mr. Wright might be able to indicate to the meeting some such new outlet. As it was, the paper bristled with useful information and deductions. He had learnt for the first time the precise ratio between the coke and tar required to heat a furnace. He had previously heard some of the wildest and crudest suggestions as to the possible saving to be effected, but the point was now settled beyond contradiction. When tar was used as fuel it should not be used in combination with coke. To mix up the two things was to utterly prevent the desired economy.

Mr. STEELE (Middlesbro') said that he must re-echo the disappointment of the previous speakers that Mr. Wright had not answered the query contained in the title of his paper. It had been suggested that tar might be profitably utilised in the manufacture of pavement; but this was no new idea, and afforded but cold comfort to tar producers. The gas companies would do well to meet the present conditions of trade in a liberal spirit, and should not hesitate to burn their surplus tar when there was no market for it. There were many companies throwing away tar to-day who could burn it profitably. The gas-makers of Middlesbro' had been pioneers in this matter. They had long used tar fuel in their retorts, and had always found that ordinary bricks—and very common bricks too—would stand the fire both of tar and of creosote. So far as it had a calorific value, therefore, he advised gas companies to burn their surplus tar, in order to relieve themselves of the huge incubus of a losing trade, and help the distillers to develop the higher uses of coal tar.

Mr. J. I. VAUGHAN had been much interested by Mr. Wright's remarks on the high heats obtainable by burning tar. He looked for great advantages from the extended use of liquid fuel in metallurgical operations, and in places where gas fuel could not be readily obtained, and where it would be of great advantage to be able to produce an intense heat without the dirt inseparable from coal. He would be glad to know what system of furnace was found best, and what quantity of air was delivered with the tar or creosote to produce that high heat which was said to have reduced Stourbridge bricks in 48 hours.

Mr. J. MACTEAR did not think that Mr. Wright was called upon to teach them what to do with their tar, but he had, nevertheless, thrown an immense amount of light on the direction in which they should go. He knew that the Glasgow Section had an immense amount of information on this very subject, more particularly in connection with the distillation of coal at various heats. Dr. Wallace had done much work in the subject, and would be able to give information extremely valuable in this connection. In the Dundee Gas Works tar had been burnt under the retorts for many years to great advantage, whenever the price made it suitable so to do, and in a very simple way. The necessary alterations to the furnaces did not take more than an hour or so to make, and cost, probably, only a few shillings; the building up of a bed of brickwork, and the removal of the fire-bars, being all that was required. Such retorts had been used there successfully for many years, and if the Section could get the experience of their working it would throw a great deal of light on the subject.

Mr. G. C. TREWBY (Gas Light and Coke Co.) had had experience in the burning of tar at several works, and found no great difficulty in it, provided

he had a good combustion chamber. There were certain works, however, where it would be ruinous to attempt it. Where the retorts were set running over the furnace, the effect of burning tar would be to enlarge the nostril holes and soon to bring the retorts down. Where the combustion chamber was so arranged as to run the whole length of the retorts, tar might be burnt with great economy as compared with coke at its present price. He was burning tar at four works, and considered it simply a question of the comparative values of tar and coke. He would warn those who had not yet gone into the affair to be very careful in their experiments. He had tried several ways of burning tar, and was in favour of allowing it to fall by gravitation on to a bed of breeze or coke. He had found five gallons of tar to the ton of coke a suitable proportion. He was not sure that there was a saving in labour by burning tar fuel; he feared it was a little the other way, owing to the attention that the men had to give to running the tar in. Sometimes, moreover, time was lost in filtering it, to prevent stoppage of the pipes. He thought, therefore, that nothing could be put down to the credit of tar on that account.

Professor ARMSTRONG congratulated the Society on the appearance of Mr. Wright in the capacity of chemist, since, up to the present, the gas industry had been left almost entirely in the hands of engineers. With regard to Mr. Davis's recent paper, he thought that their experience went to confirm Mr. Wright's view, that a much lower yield of tar could not be obtained by employing higher distillation temperatures; and this was just what might be expected. With respect to the intense local heat produced by tar fuel, it would be very desirable that Mr. Siemens's recent utterances on the subject should be taken more into account than they had been. The importance of having a large space in which combustion should take place had been ably put forward in his paper. It had been suggested that the time would arrive when the great bulk, instead of a selected portion only, of the tar produced would have chemical uses. The author had admitted that tar contained only about 5 per cent. of material capable of being utilised at present in chemical operations; but could they hope for any great increase in that percentage? Surely not! It was high time that chemistry should enter more effectively into the gas industry. Was the gas-maker right in his present method of treating coal? Would it not be better to deal with it so as to produce a larger proportion of residuals and a different class of coke? As now made, tar was of little service except as fuel, and although its quality might be improved in the future, its value for other purposes would be little enhanced thereby. He thought that in future we should aim at in some way improving the quality of our gas. Dr. Percy Frankland had brought forward facts supporting the contention of his father that the quality of gas had deteriorated, and no other conclusion was possible. The increased illuminating power of gas now-a-days was chiefly due to the improvements effected in gas burners. The speaker alluded, in conclusion, to the disadvantages arising from the Act of Parliament fixing the present standard of illuminating power, and to the benefits which would result from its repeal.

Mr. G. ANDERSON had been interested in the production of tar for some thirty or forty years, and had made many experiments, somewhat of the nature of Mr. Wright's, on the utility of making gas from tar and other like substances. He had long ago come to the conclusion that the best material for the commercial manufacture of gas was coal. The figures put before them were very valuable, and indicated results very similar to those obtained roughly by

himself. The calculation of 12·6 gallons of tar per ton of coal was, he considered, too high. That quantity would not be obtained as a rule from Newcastle coals, though it might be from some others. As to the high heats obtained by burning tar, that was simply a question of furnace construction. If the brickwork were brought very low down to the furnace, as some retorts were set, the result would be as Mr. Wright had pointed out. But if one removed the central retort immediately over the furnace, and had a number of retorts radiating from this centre, a large combustion chamber would thus be provided. The combustion would first take place on the furnace bed, and the products would be carried up into this large open space. Under such conditions there would be less wear and tear on the furnace than with coke fuel. Heat was not the only thing which destroyed a furnace; there were other more mechanical circumstances, such as clinker, and the necessity of keeping the door open at times, which led to the cracking of the brickwork. If the furnace were kept almost constantly closed, as when tar was used, there was not only a saving of expense but, as Mr. Wright had said, a saving of labour. He had recently seen a number of letters from gentlemen describing most ingenious methods for getting their tar to run. He had gone through that experience thirty years ago, and had found out at last that there was nothing wrong with the tar. It had simply been allowed to get foul, and thus extraneous substances had stopped up the pipes. If the tar were carefully kept as it was made, there was nothing to fear as to its running freely, provided it were run in at a proper temperature—*e.g.*, at 80 to 100 degrees. In winter time it was harder to run; but even then it only wanted warming. A boy could work a tar fire, whereas a strong man was required to work a coke fire. His own practice had always been to arrange during the spring and summer what quantity of tar would have to be burnt during the next winter, then to put up the necessary proportion of tar furnaces. He had found 70 gallons of tar to give the same heating power as a chaldron of coke, and 70 gallons of tar, at a penny a gallon, would cost only 5s. 10d. He could not credit that an ordinary furnace could be altered into a tar burning furnace at a cost of a few shillings, for he had made the attempt and failed. Working in London, his difficulty had been to get a furnace which should burn tar without creating a nuisance, and in which the stoker could not burn coke and shut off the tar. After many trials, he had succeeded. His furnace was simply an inclined plane, at an angle of 20 to 30 degrees, higher in front, so that the tar would run down. The inclined plane was kept some 6in. from the back of the furnace, and about a foot higher than the usual bed, so that air could enter by the ashpit as well as with the tar in front. The tar soon made enough breeze to fill the ashpit, and the air passing over this became hot before entering the furnace. With such a furnace tar could be burnt without producing smoke; if smoke did result, it was simply due to mismanagement. He had at one time sold nearly all his tar for the purpose of making pavement, first depriving it of some of its naphtha, and thereby rendering it more suitable for the purpose. If crude tar were put into inexperienced hands for the manufacture of paving material, the result must be failure, and thus tar would get a bad name. At another time, finding a difficulty in selling his breeze, he got a machine, and combined the tar and breeze into blocks, and sold it for fuel in that form. He was in Dublin a few months ago, and found the same thing being done there on a large scale. There were a number of things of that sort which gas managers should think about.

Mr. WRIGHT, in reply, said: One or two gentlemen had touched upon the question of the suitability of particular furnaces for tar firing. He would like to ask what was the material of those furnaces?

Mr. LIVESEY said the material in his case was Stourbridge bricks.

Mr. WRIGHT was under the impression that in London fire-bricks of a better material than Stourbridge clay were generally used, and would be glad to know if it were not so. He had been charged with giving no answer to the question contained in the title of his paper. He thought that he had said distinctly that his view was, that when the price offered for tar was below its value as fuel, then, as a mere business consideration, it should be used as fuel. On the other hand, if makers could obtain for their tar a fraction more than it was worth as fuel, then they were bound to sell it. He considered that the question could not be treated on any other lines. He was exceedingly sorry if he had misapprehended Mr. George Livesey's meaning. He had the greatest respect for Mr. Livesey, and would be very sorry if anything he had said should hurt his feelings. But he was certainly under the impression that Mr. Livesey had advised tar producers to burn a certain proportion of their tar with the idea of getting 2d. per gallon for the remainder. Mr. Humphrys had experienced the running down of a furnace. He would like to ask him if he was not now using a better material.

Mr. HUMPHRYS replied that he was using the same sort of bricks now. The cause of the misfortune was too much damper.

Mr. WRIGHT continued: It seemed that experiences differed. In his own case, the only bricks he could get to stand the heat of a tar fire were silica bricks. He could conceive it possible to have a tar fire with ordinary brick, if the fire were kept down, and if the combustion were very imperfect. But such a state of things was not possible with him—he must get a perfect combustion. All his experience was, that if he got a perfect combustion, and burnt a sufficient quantity of tar, then the temperature was very high and the local heat very great. Mr. Jones had spoken of tar pavement. In some cases he had found that makers had sold as much as 24 per cent. of their production for asphaltum purposes; in other cases makers would sell none at all for that purpose, and those who required it had to buy from the tar distiller—which he thought was a better state of things. One thing had struck him very forcibly with respect to this liquid fuel. The temperature of the flame might be as high as one wished. With compressed air, a 1½ inch bar of iron, held in it for a few minutes, ran like water. Whatever the experience of other gentlemen might be, he could say from his own experience, that under the action of good tar flame Stourbridge material ran, not like treacle, but like water. Dr. Armstrong had said that there was very little hope of the great bulk of the tar produced coming into use for chemical manufactures, there being so large a proportion of pitchy matter in it. He believed that on an average there was about 25 per cent. of free carbon in tar, but he could not see why the remaining 75 per cent. should not be utilised in chemical manufactures. Mr. Anderson had said something about smoke. Well, with tar firing, the line of demarcation between perfect and imperfect combustion was very sharp. One should regard tar as a gaseous fuel the moment it was in the furnace, save that proportion of it which was free carbon. And as with gaseous fuel a large excess of air was not necessary to obtain perfect combustion, so he had found that a fraction more tar or less air would produce smoke, and *vice versa*. Perhaps some-

thing might be done in the direction of getting an imperfect combustion in the furnace and burning the smoke in the flues. He had had some little success in that way, but could not speak fully of it at present.

Liverpool Section.

Chairman : Prof. J. Campbell Brown.

Vice-Chairman : Dr. F. Hurter.

Committee :

J. Atleek.
E. G. Ballard.
Ernest Bibby.
H. Brunner.
J. C. Gamble.
D. Herman.

J. W. Kynaston.
E. K. Muspratt.
Jas. Simpson.
A. Norman Tate.
A. Watt.

Local Sec. and Treasurer : W. P. Thompson, 6, Lord Street, Liverpool.

Meetings will be held at the Chemical Laboratory, Brownlow Street, on the following dates (1st Wednesday in the month), at 7 p.m. :—

Dec. 1.—Dr. Gustav Shack-Sommer, "On the Manufacture of Sugar."

Dr. Hurter, "On Pyrometers."

Meetings will also be held on Jan. 5, Feb. 2, March 2, April 6 (Annual Meeting), and May 4, and the following papers have been promised :—

Mr. James W. Westmoreland, "On the Determination and Valuation of Copper in Ores and Products," and "On the Determination of Sulphur in Pyrites."

Mr. V. C. Driffeld, "On Boiler Management."

Dr. George Archbold, "On the Manufacture of Starch."

Mr. G. Watson Gray, "On the Estimation of Tin in Wolfram Ores."

Mr. A. Norman Tate, "On Melting Points."

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

A Meeting of the above Section was held in the Chemical Theatre of the University College, Brownlow Street, on Wednesday evening, November 4, 1886.

PROFESSOR CAMPBELL BROWN PRESIDING.

CHAIRMAN'S ADDRESS.

PREVIOUS discussions at more than one Section of the Society of Chemical Industry have indicated that many members are not satisfied with the state of technical education in this country. If every one who is to be engaged in chemical manufactures were to pass through a course of training such as it is my intention to sketch to-night, from preliminary school-days onwards so far as capacity and means would permit, the waning or lost supremacy of this country in manufacturing industry, of which we hear so much, would, I think, soon reassert itself, and that must be my excuse for bringing the following remarks before this Section of the Society.

The full course I shall sketch is intended for masters, employers, directors and managers, and their professional advisers and assistants. For workmen and foremen I should recommend, not a different kind of education, but that their education should commence in the same way, and differ only in degree from that of managers. Necessity will compel them to stop far short of the full curriculum, but they should go as far as they are able : you cannot give a young workman too wide an education. Combined mental and bodily training will be the best aid to workshop and factory progress, while liberal and scientific culture will be infused into the occupations of the people.

It has been made sufficiently clear by those whose opinions carry most weight, that the special details and the most recent improvements in each branch of

manufacture are only to be learned in the works themselves. What then can the young chemical technologist learn at college beyond the elementary principles of the science and practical details of analysis, with, perhaps, special training in the rapid performance of such forms of analysis as are most employed in the kind of works he is likely to enter? Much has also been said already, at this Section and elsewhere, regarding the imperfections of the Science and Art Department system, and other similar organisations for promoting scientific and technical teaching. I think that while these organisations have done a great deal in the way of spreading the desire for and opportunities of learning something about chemical science, one of their defects is that they have unintentionally fostered the idea that when a student has got to the upper end of their system he is a chemist. He may have learned—as is indeed customary—the general outlines of several branches of manufacture in the course of his attendance on lectures, but it is not until he has mastered the principles of the science and most of the details of analysis that the student is ready to commence in earnest, and with effect, the study of Technical Chemistry.

Unfortunately there is a too common impression amongst students and others that having reached this stage their chemical education is finished, whereas it has only commenced. Young men frequently come to me stating that they have passed such examinations and taken such and such certificates and prizes in the advanced stage, honours stage, etc., in this and that branch, and asking me to employ them or recommend them for employment as chemists. They are very much astonished when I tell them, as gently and kindly as possible, that they are only now ready to commence their strictly professional training, and that they are worth very little in the shape of salary until they really know their profession.

Has not this flooding the country with untrained or partly-trained men, who think they are trained, something to do with the complaints so frequently heard of the employment of Germans instead of Englishmen as chemists in works where intelligent and skilled work is required? I think it has as much to do with these complaints as the readiness of the German to work for less pay than the Englishman. German students are, on the average, better trained, because they persevere longer at school and college, and sometimes work longer and harder for themselves while they are there, and they do this because German manufacturers pay for highly-trained men, and will not have the half-educated class which some people in this country are supposed to be willing to employ.

At a time, then, when the necessity for better technical instruction and training of all children who will have to earn their own livelihood in later life is forcing itself on the attention of the public, while at the same time there is a pretty general feeling that if there is not over-pressure there is at least sufficient pressure upon the intellectual powers of growing children in our Board Schools, it may not be amiss to consider for a moment the relation between theoretical and practical instruction, and how they may be best co-ordinated in the education of those who are to carry on the industries of this country as workmen, foremen and managers.

Those who insist on the fact that the principal aim of ordinary school training should be to open the child's mind and discipline it to think and study, are very apt to believe that all the time in early life must be given up to the attainment of this object, except what is reserved for recreation and rest, and that any technical or special training should be post-

poned to a later period, when the boy or girl is ready to leave school.

On the other side it is urged that few of the boys and girls now in the Board Schools can expect to earn their living by the exercise of their brains alone; most of them must work with their hands, and must learn some handicraft. While the schoolmen of the old stamp maintain that apprenticeship after leaving school is the best method of training workmen, others point out that before the days of compulsory education boys began to learn the use of tools at a very early age, and that to become a good workman it is necessary that a boy should begin to use tools early.

There can be no doubt that much of the inefficiency of modern workmen is due to the neglect of masters and journeymen to teach apprentices in the thorough way which was in former times common; and, in fact, to the too frequent neglect of masters to see that their apprentices are taught at all. Apprentices are allowed to see journeymen working, to carry their tools and utensils—in short, to attend and serve the workman—but they are not taught their trade. The prolongation of school days tends only to increase the evil, unless something further is done to supply the place of the earlier apprenticeship.

Hence has arisen a demand for the erection of workshops for training school-boys in the use of tools, and for the recognition of such training as a compulsory subject, and one which will earn grants under the Education Code.

Now I think that if we look at this subject from a physiological and common-sense point of view, it will be clear that: (1) A sound early mental training is essentially necessary to every child that has afterwards to fight the battle of life in a civilised country. Good school education is therefore the first essential after a sound healthy body. (2) If the hands are to do any kind of work skillfully in after life, they too must begin their training early: and (3) These two kinds of training, instead of clashing, are mutually helpful.

Properly imparted, instruction and practice in handling tools will be not only useful, but still more will be a pleasure to the boy, jaded by his ordinary school routine of lessons, and will be welcomed by him as a relief and an amusement; while the change of work, employing an entirely different set of organs, will, instead of interfering with progress in school work, render it both more efficient and more agreeable. The exercise of one set of functions will be complementary to the other, and the individual receiving the double training will grow up with all his faculties more equally and more fully developed.

The questions then arise: Should the workshops be attached to each Board School, and should each boy attend part of each day at the workshop? Doubtless this would be the ideally perfect system; but it is not practicable, nor is it necessary in order to accomplish what is required.

It would be sufficient, and quite within what is practicable if workshops for different kinds of trades were erected in a few well-chosen districts of a town, and each scholar in every Board School were required to spend a sixth day every week in one or other of those workshops, such day being counted as part of the attendance recognised and required by the Education Department. Thus the boys from different schools could attend the selected workshops on different days of the week, and discipline, regularity of attendance, etc., could be looked after just as in the case of any of the three "R's."

I venture to say that with most boys the workshop day would be looked forward to almost as to a holiday; the physical advantage to him would be nearly, if not quite, as great as if it were a holiday, owing to the regularity of the recurrence of this

change of work, and he would return to his mental work with greater zest. A healthy mind and a healthy body alike crave exercise, and the school or lecture room, and the workshop, if they are properly conducted, and are judiciously mixed, should each be a source of enjoyment. By this system I do not think that the amount of ordinary school work would be lessened; but if it were, the decrease would be very slight, and the reply to objections is, that some provision for training the hands and muscles to work is essential to an embryo workman, is beneficial to an embryo gentleman, and must be had at any sacrifice if we, as a nation, are to maintain our position in the face of other competing nations, and the system I have sketched is that which of practicable methods accomplishes what is required with the least sacrifice.

It is by no means essential that a boy should limit his choice of a handicraft to that or those in which he has received his early training. As any subject well and systematically taught is capable of opening and expanding the intellect—as, for instance, a good classical education is frequently of the greatest value to a young man who, perchance, does not open a Greek or Latin book after he has left school or college—so a boy who has learned to cut and plane timber and carve wood in his early school-days will be a better plumber or engine-fitter when he begins to go out as an assistant or apprentice, than a boy who has never handled a tool, except by chance, until he has reached the age at which he is allowed to leave school. It is the training of the muscles to work habitually in concert with the eye and mind that is wanted, rather than acquaintance with the precise mechanical details of his future life's work.

The only effective training in handicrafts for the immediate purpose of earning a living must be given under conditions which hold in actual everyday life; and this can only be done in workshops conducted on strictly commercial principles. The aim of school training should be to develop and train all the faculties which can be useful in after life, no matter in what lot that life may be cast. If you want a good workman, a quick observer and an intelligent thinker, you must begin to train all the faculties at the earliest period that will not interfere with physical development; you must not give a boy or girl too much study nor too much work, but give them broad general ideas, good habits of mind, habits of observation and activity which will enable them afterwards to appreciate and employ the opportunities of higher instruction which they may have as they advance in years.

In the teaching of science it is a great mistake to aim *specialty* at imparting a knowledge of facts which will be of use in after life. It is the desire to do this which has gone a great way in encouraging the multiplication of science subjects in schools. It would be far better to teach one science subject substantially and well than to teach a smattering of several. Every boy and girl, in whatever sphere of life, should be taught one science as a part of ordinary school training, but the mistake is too frequently made both in science teaching and in ordinary school routine, of forgetting that it is the mental training and discipline, and not the storage of facts, that form the valuable feature of school work—the training of the understanding and the development of the reasoning faculties rather than the exercise of mnemonics.

And here let me remark in passing, that the tendency of the training in those schools in which living or dead languages are the chief characteristic feature, is to produce an exaggerated idea of the importance of words. The highest result of such a training, even when successful, is to produce a command of

words and the power of placing ideas clearly before a listener, valuable faculties certainly, which must not be neglected, but apt to be a bore when the ideas are few or wanting, and positively dangerous when the ideas are not well thought out and founded on truths. The command of language is a valuable tool in the hands of a student or investigator, enabling him to read the thoughts and observations of others both in his own and other countries and times, and to communicate his own thoughts and observations to others; but the mastering of this tool is not, or ought not to be, the sole aim and end of any man or woman's education.

The introduction of science into every stage of school and college life, if it were properly taught with the special view of getting the greatest *educational* (as distinguished from *instructive*) results from it, would be a most valuable corrective of the tendency just alluded to.

While the study of one science should be made a compulsory item in ordinary Board Schools as well as secondary school work, I think that one science at a time is perhaps enough until study begins to be specialised in some direction.

For the purpose of training the powers of observation and classification, the study of natural history (either vegetable or animal) is best adapted, and this should come first. Every boy and girl should be well taught the elements of one branch of natural history.

To train in exact and logical powers of reasoning, Euclid and some of the other branches of mathematics, pure and applied, are most suitable; every boy who can stay at school long enough should be taken as far in mathematics as his time and ability will permit.

To gain carefulness in experiment, watchful humility in seeking evidence before drawing conclusions, to acquire the habit of putting one's opinions to the test, to correct the tendency to vague speculation and to convince one that nature overlooks and forgives no error, there is no training better, and very little as good, as that of the chemical laboratory.

This ought to come at a later stage. To study chemistry with full or even fair profit, the knowledge of language must be far advanced, the habit of observation must be already acquired, and the power of reasoning and calculating must be beyond the elementary stage. At the risk of wearying you by repeating much of what has been again and again said by many speakers and writers, I must insist on the necessity for making the teaching of chemistry practical as well as theoretical from the commencement. Without experimental illustration to connect words with things, words only are taught, and ideas are not understood. Nothing will more certainly disgust a student than to be forced to learn what he does not understand. This is a plea for making even elementary chemistry a somewhat advanced subject, and for teaching it experimentally.

But although a good course of lectures, well illustrated by experiment, is a pleasant exercise of the reason, it partakes too much of the nature of an amusement unless something more is added. To get the educational value which I have mentioned out of the study of chemistry the student must himself work in the laboratory from the beginning. The object of education is to produce a man who not merely knows things, but who can do things. Habits of action are needed as well as habits of thought. The student should be allowed to prepare for himself some of the elementary substances and simple compounds which he sees made or used on the lecture table, and to perform with his own hands some of the experiments illustrating or demonstrating fundamental laws.

Laboratory work of this kind should be simultaneous with the course of elementary lectures, and should

precede the study of analytical chemistry. Such a course as I have indicated is not made compulsory in any of the University or other set curricula of study, either for science students or other students; but it is of great importance, and the college whose rooms we occupy to-night has provided and recommends a voluntary class for those attending the first and most elementary course of lectures. I consider it essential. A student or a teacher does not fully understand an experiment even by seeing it performed; for the full appreciation of it he must perform it for himself, or at least must have performed something of a similar nature.

The effect of scientific training should be not to produce a mind willing to accept statements of which it has no clear conception, not to assume as correct the opinions which have been taught by others, but rather to produce the mental habit of doing all in one's power to test and correct opinions and conclusions by experimental verification, without which the process of inductive reasoning is incomplete.

To commence the serious study of chemistry by accepting the teaching of a lecturer, without at the same time attempting personal verification, is apt to produce an irresponsible, unscientific mind; it is all very well for those who only want to know what are the accepted conclusions of scientific men, but it will not do for those whose future fortunes are to depend on the successful pursuit of chemical industry. Of course, I do not mean that a student must himself prove the truth of all scientific laws and theories which he accepts—the truth can only be ascertained by the combined labours of all scientific men in all generations; but in order to be able to accept the conclusions of others with discrimination, and to judge of the value of the experimental evidence placed before him, he must begin by experimenting for himself.

Having laid a foundation by becoming acquainted with the elementary principles of the science, and having become convinced of the truth of the fundamental laws by an intelligent examination of the experimental evidence of their truth, then, and not till then, can the young technical chemist derive full advantage from a disciplinary course of analytical work, both quantitative and qualitative. The course of qualitative analysis is, in my opinion, capable of being so conducted as to be a valuable discipline in technical, medical, and scientific education generally. Rightly taught, it comes nearer to the discipline obtained by the old training in the writing of Latin versions than anything else I know, with the additional advantage that it exercises the eye and the hand as well as the mental faculties.

But to have this value it must not be merely a course of test-tubing. The mere application of what are called tests is no training, and requires nothing worthy of the name of scientific skill. No one can analyse a natural product or an artificial manure by testing for potash and similar operations. That is not analysis. A course of drill in real qualitative analysis of complex substances by the best methods, is of great value in general scientific, as well as in specially technical education.

I need not say anything here more than has been said already at this Section as to the necessity for including other subjects in a course of preparation for technical chemistry as a pursuit; such as French and German, mechanics, physics, drawing, nature and strength of materials and other engineering details; the necessity for these things is acknowledged by all, and they are provided in the technological curriculum at University College, Liverpool; Owens College, Manchester; University College, London, and elsewhere.

The technical student being now equipped for commencing the study of technical chemistry, he should be taken through the principles which are involved in the processes of some typical kinds of manufactures, his attention should be called to the improvements which have been brought about in manufacturing processes since the foundation of the industry; he should be shown how and why these improvements were made, and should be encouraged to endeavour by his own work and research to make improvements in some branch, or to make some original investigation.

He should be guided through courses of practical work on the examination of technical gases, and should be taught the principles of thermal chemistry, and made to understand how these principles can be used in technical research. He should also be accustomed to make preparations on a larger scale than the few grammes usually dealt with in ordinary laboratory work, so as to enable him to deal with materials in bulk.

In this technical stage of the student's career the method of instruction should be mainly by laboratory work, accompanied by demonstrations and explanations by the teacher, and not by lectures only. It is no doubt necessary to teach and illustrate the first principles of chemistry to large numbers by means of set lectures, supplemented by tutorial revision with sections of the class. But the average student cannot absorb all that is gone over in an hour's lecture, during which no allowance can be made for differences in individual mental inertia, past knowledge, distraction of mind, occasional absence, and so forth; nor can he give expression to his difficulties and get a supplementary explanation unless he comes in closer contact with his teacher than is possible in the lecture-room. Demonstration in the laboratory to small numbers at a time is the most efficient mode of teaching the advanced branches of chemistry.

In these latter days, when organic chemistry advances by such rapid strides, and when practical applications of old laboratory curiosities are pervading our every-day life; when new organic compounds of great complexity and marvellous beauty or striking usefulness are being discovered or brought into use every week; when new substances extracted from plants, or made synthetically in the chemical works, are being introduced for medical use in ever-increasing numbers; when some forms of our old friend nitrocellulose meet us, not merely in the shape of gun-cotton and collodion, but in the binding of books, the coverings of our chairs, and the combs of our toilet tables; when the profits of gas-making have come to depend on the utilisation in an unlimited variety of ways of the formerly despised waste-product, tar;—it is time that every one about to be engaged in chemical industrial pursuits should become acquainted with systematic organic chemistry, learn to carry out with his own hands the leading typical reactions by which one form of organic compound is transformed into others, and learn practically modern forms of organic research.

Organic chemistry is a very tempting pursuit to the advanced student; there is no branch of natural science in which something which has never been seen before can be made or discovered with less expenditure of labour and skill. And accordingly in organic chemistry, even more than in mineral chemistry, we too frequently see a student undertaking a showy but useless immature original research before he has learned his principles or become properly trained in the performance of a goodly number of typical examples of already known transformations. No sooner has he got up in words and formulæ a

tabular arrangement of the classes of organic compounds, or a few of them, than he starts an original research and publishes an account of the preparation and properties of a new substance, to which of course he has to give a long name in accordance with its derivation and supposed structure, the existence of which has been foreshadowed by previous investigators, the mode of whose production any organic chemist could suggest, and which any chemist could produce whenever it might be wanted.

Do not think that I undervalue original research; on the contrary, I fully appreciate its value and the pleasure derived from it, and would have original research kept before the mind and imagination of the student as the goal which he should constantly aim to reach. Nor do I desire to limit research to utilitarian objects in the narrow sense of the term. But I deprecate the substitution of the easy preparation of a new chemical individual for a difficult and somewhat prolonged practical training in work that has already been mastered by previous investigators and in the performance of the leading general reactions for the preparation of typical series of carbon compounds.

The student commencing the study of organic chemistry should be familiarised not so much with the formulæ of series, but with the substances themselves. The last thing, not the first, should be to get the formulæ as short-hand expressions of things and facts which he knows. Care should be taken to avoid allowing him to get the impression that formulæ have any other use or function than this.

Having made the personal acquaintance of organic compounds, and learned the classification into series by reference to the substances themselves, and not from printed tables or blackboard diagrams only, he should be made to chlorinate a paraffin, and separate and distinguish the isomeric products; then to convert a haloid ether into an alcohol, to oxidise an alcohol into an aldehyde and an acid successively. And so on through the more important operations in daily use in organic laboratories. Then and not till then, should he be allowed to work out in detail some special group, and encouraged to take up some line of original research. Thus he will be equipped for whatever work he may be required to do when he goes out into practical life.

It is not altogether the fault of teachers and institutions that practical training in organic chemistry is not carried on with full systematic persistency. It is more the fault of students and their parents, and of employers, who do not allow, or at any rate encourage young men to persist long enough in the unromantic and not directly remunerative detail of advanced pot-hooks. There is a temptation to turn their knowledge to pecuniary account as soon as it is sufficient to secure the smallest return, to the pretty certain sacrifice of future advancement.

I need not remind members of this Society of the close connection between the development of Chemical Science and the progress of Chemical Manufactures. Science is knowledge, and knowledge is power, especially to a manufacturer. Every one now recognises the mutual obligations and the necessity for mutual co-operation between scientific men and manufacturers. The study of the history of chemistry is as instructive as the history of nations. Looking back in the history of chemistry, we see that the most highly-trained mind learns to cultivate science for its own sake, and finds it one of the noblest pursuits; but even from a narrower point of view the thing most worthy of attention is not the direct pursuit of wealth. In ancient times the pursuit of chemistry consisted mainly of the working out of methods for extracting gold and silver; and

later, in the times of the Alchemists, the principal object of research was the philosopher's stone or the means of transforming the baser metals into gold.

During these periods no great progress was made in either chemical science or manufactures. It is true that some interesting and useful substances were discovered—and kept secret; such as, for instance, phosphorus by Brandt and Kunkel. But the knowledge of phosphorus and its preparation and properties not being made widely known, phosphorus was not much wanted, its use did not become general, and its manufacture did not flourish, the study of it was not stimulated, and its sources and the rationale of its manufacture were not investigated; and so on in other cases.

It was not until the knowledge of chemical substances and processes was very widely spread that a great and rapid development, both of science and manufactures, resulted.

The pursuit of truth for its own sake is best both for science and manufactures. Of course, any branch of manufacture, in order to flourish, must pay. Yet, in order to be successful as a manufacturer as well as a student of nature,—to make the most money even, by manufactures,—I venture to say that the consideration of money making must not be the most prominent thing before the mind, should not be the direct aim.

If any one proposes to carry on a new manufacture he first ascertains that the thing to be made will be of use and benefit to some section of mankind. He then learns all he can about it, ascertains its most abundant sources, and seeks to find out by the study of nature's laws the most simple way of transforming the raw material into the manufactured product. The man who has the most perfect knowledge of nature's facts and who works in the most simple obedience to nature's laws, will be the most successful and will make the most money, not the less so that money making was not his direct aim.

No doubt it has often happened that a man, by more or less haphazard attempts or empirical trials, in the direct endeavour to carry on his process in the cheapest way—i.e., to make most money by it—has come ultimately to the method which is most simply in accordance with the laws of nature. But this is not the best way of doing it, and is not the most likely way to succeed.

These considerations bring us to the borders of a great moral law. But as I have already traversed a sufficiently wide field to-night, I must leave the morals of the subject to your own private contemplation.

DISCUSSION.

Mr. E. K. MUSPRATT said the question of technical education was one that was occupying the public mind of England at the present time, and it was very interesting to all of them who were engaged in manufacture by discussion to elicit what they thought was the best method of carrying out such education. He knew there were others present who had been engaged in teaching science in its application to manufacture, and who would be able to give them the result of their experience, for, after all, it was by experience they must learn which was the best method of education, and it was because the Germans and Swiss had so much greater experience that they were far in advance of us in nearly every department of education. They must begin at the bottom, and it was in the elementary schools where the foundation must be laid for the higher technical

training. He was much interested in that portion of the Chairman's address which dealt with this elementary education. They were beginning to recognise that it was not sufficient to educate the children in the three "R's." For a long time they were under the impression in this country that it was going beyond the function of the State to teach further than the three "R's"—that is, reading, writing, and arithmetic. At the earliest possible moment everybody should be trained to use his hands, his eye, and his mind. One advantage they had on the Continent was the co-ordination of the primary, secondary, and the higher education, and they were only beginning to carry this out in Liverpool. He was glad to say that since the passing of the Education Act of 1870 they in Liverpool had fairly got elementary schools to recognise the advantage of teaching elementary science. They had also two or three secondary schools where the claims of science were recognised, and they had now in the institution in which they met the opportunity of studying the higher branches. They had, further, the advantage of science and art classes, with their prizes and grants. A great number of pupils imagined that because they had taken out a certificate and received honours they were then perfectly trained in that particular science to which they had given their attention. This, of course, could not be the case. An education of that kind could not be all that was required, and what they had to look forward to in the future was that those who had passed through science and art classes should go through a course of technical education in an institution of that kind in which they were assembled. He thought that would be the direction which their education would take in future, and he was sure when they had more experience they would be on a par with Germany and Switzerland, with a system of education which would assist in developing the industries of the country. He had much pleasure in moving a vote of thanks to the Chairman for his address.

Dr. HURTER seconded the vote of thanks, and remarked that in Switzerland the necessity of giving boys a training in the use of tools had been recognised, and evening classes had been started at which boys about ten years old could learn the use of a few tools. The trades chosen for this instruction were joinery and bookbinding, or, better, cardboard modelling. The work done by the boys was excellent as regards workmanship. Still, Dr. Hurter was of opinion that the use of tools could only be properly acquired during apprenticeship. Dr. Hurter then referred to the greater length of time which is usually devoted to education on the Continent, particularly in Germany and Switzerland, and hoped that the English nation would soon improve their educational system.

Mr. NORMAN TATE said Mr. Muspratt had referred to the co-ordination of education, and this was most important. In teaching children in primary schools, their probable occupation in after-life should be most carefully considered, and in secondary and other schools this should be even more closely attended to. The training of a lad at school should have intimate connection with the occupation he had to follow when he grew up and had to work to keep himself and his wife and family. He thought that, at present, in this country this was not sufficiently considered. The Chairman had referred to the Science and Art Department. He (Mr. Tate) considered that department had done much to direct and encourage science and art education, but he thought that oftentimes too high a value was attached to the results of the examinations, and that young men were too prone to over-value their certificates and prizes, forgetting that the system of education fostered by this depart-

ment was very much of a primary character, and that the successes obtained should, at any rate as regards technical pursuits, be considered only steps to more thorough education and training. With regard to chemical studies there was now an Institute of Chemistry, but in the prospectus of that Institute, in stating the regulations for admission, too much stress, in his opinion, was laid upon instruction in schools and colleges, and not sufficient note taken of work done in practical laboratories and technical establishments. No artisan could be taught in a school how to work in a thoroughly practical business-like manner, and thoroughly practical, analytical, and technical work could not be so well learnt in school and college laboratories as in laboratories and places where the work had reference to important technical and commercial operations, but in the prospectus of the Institute time occupied in practical work, except in schools and colleges, was not recognised as part of the necessary training for admission.

The CHAIRMAN: Does not the Institute require three years' practice as well as three years' training?

MR. NORMAN TATE: The practice referred to in the prospectus was limited to the schools, and no mention was made of other practical laboratories. The latest prospectus, which he had seen but a few days ago, only mentioned certain schools and colleges.

The CHAIRMAN: The old regulations mentioned three years' practice in addition to three years' college training for the fellowship.

MR. TATE hoped the present regulations would be altered before very long, for practical men would not be satisfied as the regulations now stand.

MR. FITZPATRICK said he was highly delighted with the paper which the Chairman had given them that evening, as there was a vast amount of instruction in it. With regard to the Liverpool School Board, he was one of the denominational members of it, and he must say there was not one of the members of the Board who did not take a most intense interest in the scientific instruction of the children, but their great difficulty at present was how to inaugurate any system of technical education. The principal difficulty they had was in the early age at which children left school, and being in school only five days a-week. If they had one day of technical training, that must necessarily be taken from the teaching in the three "R's," and they were obliged to insist upon the subjects being taught which were stipulated in the code. It was not for School Boards to inaugurate any system, but for Parliament, and if Parliament could see its way to giving a technical education, there would be no people more delighted than the denominational members of the School Board. He thought it was useless to point to Germany or Switzerland, because, as has been stated by one speaker, brought up in Germany, he was 23 years of age before he was taken away from school, whereas in England children were taken away at 12 and 13 years of age. The Germans surpassed them in technical knowledge and skill, they surpassed them in the study of the ancient classics, in the study of Dante, and even in the study of Shakespeare. The English were probably given too much to roast beef and plum pudding, thereby clouding the native brilliance of their intellect, but at any rate in trying to promote technological education let the circumstances of the English people be taken into account; they must learn from foreign nations what was applicable to themselves, and not take what was totally inappropriate to the English people.

ON THE COMPOSITION AND DECOMPOSITION OF REDONDA PHOSPHATE.

BY WALTER TATE, F.C.S.

THE mineral known as redonda phosphate has for many years engaged the attention of numerous technical chemists, especially of those interested in the industry of chemical manures. The fact that it affords one of the richest and cheapest known sources of phosphoric acid has stimulated experimenters to endeavour to obtain from it that compound in an available and useful form. The raw mineral contains phosphoric acid equivalent to about 84 per cent. of tri-calcium phosphate, while the calcined material equals about 107 per cent. Hence, considering the low price at which it is obtainable, the redonda phosphate supplies phosphoric acid at a much lower cost than most other commercial mineral phosphates. But the circumstance that its phosphoric acid is combined in an insoluble state with alumina and iron oxide is the cause of its low commercial value, and its conversion into phosphate of lime economically, is the great desideratum. Containing upwards of 20 per cent. of alumina, it is also available as a source of alum and sulphate of alumina, if the phosphoric acid and iron oxide could be separated from the alumina without too great an expense. The writer has been for the last year or two chiefly occupied in experimenting with this phosphate, and has devoted this paper to a few notes on (1) the composition of the phosphate, and (2) its decomposition or decomposability.

THE COMPOSITION AND FORMULA OF THE MINERAL.

The following represents its average composition:—

• Phosphoric acid (P_2O_5)	38.50
Alumina	22.00
Iron oxide	10.30
Insoluble siliceous matter	6.50
Undetermined, including traces of lime	1.00
Water (loss on ignition)	21.50
	100.00

• Equal to tri-calcium phosphate, 84.04

Its composition is comparatively simple, and shows it to be essentially a hydrated phosphate of alumina and iron. The silica in good specimens is very small in amount, being often less than 1 per cent., and is, I believe, merely an extraneous impurity derived from the surrounding rocks or matrix.

In a paper read before the London Section of the Society (Journal, March, 1885), last year, by W. J. Williams, equations are given which convey an inaccurate idea of the composition and character of the phosphate. No analysis is furnished, but the following formula— $AlPO_4 + 2FePO_4 + SiO_2$, from which it would be inferred to be chiefly a phosphate of iron, with a minor proportion of alumina phosphate.

Now, this is evidently incorrect, the analysis showing that the proper formula for the mineral is:— $3AlPO_4 + FePO_4 + 18H_2O$; or, in other terms, $4P_2O_5, 3Al_2O_3, Fe_2O_3, 18H_2O$. The correctness of this is proved by calculating the figures of the analysis (after deducting the silica for the reason before stated) when the following is the result:—

	Calculated from Analysis (less Silica).	Theory $4P_2O_5, 3Al_2O_3, Fe_2O_3, 18H_2O$.
P_2O_5	11.17	41.73
Al_2O_3	11.23	11.79
Fe_2O_3	23.53	22.70
H_2O	23.00	23.80

The fact that the mineral consists principally of aluminium phosphate rather than of iron phosphate is not unimportant, if it be true, as maintained by H. B. Yardley (Journal, August, 1884) that iron oxide is the chief or sole cause of "reversion" or "going back" of "soluble phosphate" in manures, and not alumina, as was at one time supposed. Whence it appears that a phosphate of aluminium is of much more practical value to the manufacturer of superphosphate and other soluble manures than a phosphate of iron containing the same amount of phosphoric acid. The utility of obtaining a true knowledge of the composition of the phosphate, and of correcting inaccurate impressions, must be sufficiently apparent.

DECOMPOSITION OR DECOMPOSABILITY.

The facility with which the phosphate yields to the action of reagents, both liquid and solid, is remarkable. The reagents employed include, besides sulphuric acid, several sodium salts, such as the chloride, hydrate, carbonate, sulphate and nitrate. It is beyond the scope of this paper to enter into the details of the various processes which have been proposed, and most of which are to be found described in published patents. My chief object is to show by the results of some experiments that I have made that the phosphoric acid in the mineral can be obtained in an available form more economically than was formerly supposed possible.

Hitherto it seems to have been taken for granted by chemists who have previously worked at this phosphate that in order to decompose in the "dry" way the aluminium-iron phosphate, so as to render the phosphoric acid soluble, it was essential to employ such a quantity of sodium salt as would not only suffice to form tri-sodium phosphate, but also sodium aluminate. For instance, on referring to the paper by Williams, quoted above, it will be seen that he used such a proportion of sodium chloride or sulphate. The results of my experiments have proved, however, that the phosphate can be decomposed by much less sodium salt than would be required under the above supposition. In fact, I have found that the mineral is decomposable by such a quantity of sodium salt as supplies sodium in amount just sufficient to combine with the phosphoric acid to form tri-sodium phosphate, allowing none for the alumina. The difference in the quantity of sodium salt in the two cases is very considerable. Thus, since there are in the phosphate four molecules of phosphoric acid to three molecules of alumina, and since a molecule of alumina would combine with the same amount of sodium as a molecule of phosphoric acid, it is clear that the saving of sodium salt is equal to three parts out of seven, or nearly forty-three per cent.

The following is a short summary of a few out of a large number of experiments performed, in all of which the quantity of sodium salt used was only just that required to form tri-sodium phosphate:—

A. Decomposition by Sodium Chloride and Steam.—A mixture of finely-ground phosphate with sodium chloride and sand was moistened, made into cakes, dried, and heated to redness in a furnace through which a current of superheated steam was passed. Copious evolution of hydrochloric acid gas occurred, and the amount of decomposition was, by analysis, found to be as follows, in three experiments:—

P ₂ O ₅ in Original Phosphate Calcd.	P ₂ O ₅ rendered soluble.			Average Decomposition per 100 P ₂ O ₅ .
	I.	II.	III.	
45.0	39.0	40.7	37.9	86.6

Only traces of alumina were rendered soluble.

B. Decomposition by Sodium Sulphate and Carbon.

—The phosphate was mixed with sodium sulphate (salteake), some coal and sand, and made into cakes or "balls," as before, which were then heated to redness for some hours in a closed furnace.

The resulting product gave these figures on analysis, in four experiments:—

P ₂ O ₅ Original Phosphate Raw.	P ₂ O ₅ rendered soluble.				Average Decomposition per 100 P ₂ O ₅ .
	I.	II.	III.	IV.	
38.5	33.3	35.1	31.6	37.2	91.0

Traces only of alumina in solution.

C. Decomposition by Sodium Nitrate.—The mixture of ground phosphate and sodium nitrate was heated in a crucible to redness until nitrous gas ceased to be evolved.

The product examined gave the following figures in four experiments:—

	Original Phosphate	RENDERED SOLUBLE.				Average Decomposition.
		I.	II.	III.	IV.	
P ₂ O ₅	38.5	36.5	37.3	37.3	37.5	96.4
Al ₂ O ₃	22.0	—	8.9	6.3	10.0	38.1
Fe ₂ O ₃	10.5	—	—	—	—	—

Here, over 96 per cent. of the phosphoric acid was made soluble, and over one-third of the alumina.

The result of the lixiviation of the foregoing products is practically a solution of tri-sodium phosphate, which is readily convertible into tri-calcium phosphate by precipitation with milk of lime, or a soluble calcium salt. The tri-calcium phosphate can then be converted into soluble mono-calcium phosphate by the usual method of treatment with sulphuric acid.

Whether the economy effected in the decomposition of the mineral, as indicated in this paper, is sufficient to bring the practical working of the phosphate within the range of commercial success, is a question which I shall not attempt to decide; but it is unquestionably a step in that direction.

In conclusion, it may not be out of place to observe that the redonda phosphate is decomposable by natural agencies, or climatic influences, when applied in a powdered state to the soil.

Field experiments, by the late Dr. Voelcker, proved that the redonda gave results with root crops and cereals superior to those obtained with ground (Cambridge coprolites, also better than precipitated phosphate of lime, and equal to dissolved bones. (*Journal of Roy. Agr. S.* 1882–83). It is probable that its use in the natural state, but powdered finely, might prove of service on many soils. The fact that it supplies phosphoric acid free from lime may be an advantage in its application to those cultivated lands which, by the long-continued treatment with chemical manures containing an excess of lime, have become overstocked with that substance.

DISCUSSION.

Mr. BRUNNER disagreed with the reader of the paper that this phosphate was a cheap material, and the reason of this was, he supposed, that the holders of it were sufficiently wealthy to hold it. He could

quite endorse what the writer said with regard to the experiments he had made, as he had carried out most of them himself, and with much the same results that he had found. Mr. Brunner then described the process which he patented for the manufacture of phosphate. He quite believed that although inventors would be losing their time in taking up this redonda phosphate, he believed it was a good manure in itself, and all they wanted was to secure it at a reasonable price.

Mr. NORMAN TATE said in making redonda phosphate practically useful, the question of price was of considerable importance. He thought there was a deal of nonsense in so dealing with natural phosphates by manufacturing processes as to produce the large percentage of soluble phosphates now asked for by dealers and users. In actual use much of it becomes at once insoluble in the soil, and he believed a good proportion was wasted in the drainage. Instead of pandering to the idiosyncrasies of buyers and users in this respect, he considered it would be far better to grind up the phosphates into a very fine condition and mix it with the soil, and then probably the plants would prove far better chemists than we are, and turn it to profitable account.

The CHAIRMAN said that the paper was one of considerable interest. Some ten years ago a similar phosphate had been a drug in the market, and was offered at 10s. per ton. At that time many chemists had tried to utilise it. One method tried was solution in excess of sulphuric acid, neutralisation by alkali, and separation of the alum from the phosphate by crystallisation; but ammonia and potash had been found too expensive for commercial success, while sodium alum was not sufficiently crystallisable to effect a separation. In Mr. Tate's method it seemed wasteful to first form sodium phosphate and then convert it into the cheaper calcium compound. Would it not be better either to use the sodium phosphate as such, or to endeavour to form a calcium compound direct? For manurial purposes there could be no doubt that redonda phosphate mixed with organic matter would be a valuable manure. He concluded by proposing a vote of thanks to Mr. W. Tate for his paper. This was carried unanimously, and

Mr. WALTER TATE, in reply, said: As regards the cheapness of the redonda phosphates, the price at which it is now obtainable, delivered at Liverpool, affords about 19lb. of phosphoric acid (P_2O_5) for 1s., which is, I believe, a much lower price than any other phosphate in the market. The reason for converting the tri-sodium phosphate into calcium phosphate is that the demand for the former is very limited, and the same is true of potassium phosphate. As to the direct use of the natural phosphate as a manure, the chief obstacle to be overcome is the prejudice of the average agricultural mind. I have tried the calcium chloride method, patented by Mr. Brunner, but found the separation of the calcium phosphate from the alumina and iron oxide, by means of acid, impracticable.



THE ELECTRICAL DEPOSITION OF DUST AND SMOKE, WITH SPECIAL REFERENCE TO THE COLLECTION OF METALLIC FUME, AND TO A POSSIBLE PURIFICATION OF THE ATMOSPHERE.

BY PROF. OLIVER LODGE, DSC.

THE research of which I have the honour to speak to-night, takes its origin in an observation made by Dr. Tyndall, of which he has published an account in

the proceedings of the Royal Institution, London, for 1870.

The phenomenon discovered by Dr. Tyndall was a dark or dust-free space formed over a hot body when held in strongly illuminated dusty air. A flame or hot poker held beneath the concentrated beam of an electric lantern shows it perfectly, and the appearance is as of wreaths of black smoke.

That it is not smoke, but anti-smoke, is perhaps rendered most evident by observing the utterly different appearance of smouldering brown paper held in the same place. In fact it is manifest that what we see in a sunbeam is not the beam itself, but the dust illumined by it. It is somewhat misleading, though customary, to speak of the motes as rendering a sunbeam visible; it is really the beam which renders visible the motes. And the more motes there are, the more there is to see, naturally; hence smoke in the beam greatly increases its luminosity, while anything which removes or expels the dust-particles destroys its luminosity, leaving a clear dark space!

Now what is the cause of this dust-free space? The first idea was that the dust is burned and destroyed by the flame. But this explanation is negatived by using a moderately warm body, say a hot kettle, and noticing that above this also the dark space is perfectly distinct, though narrow.

Dr. Frankland next suggested that much of visible dust consisted of moisture, and that it was dried and rendered visible by warmth. Both explanations can be at once disproved by replacing common miscellaneous dust of unknown origin by a carefully chosen smoke, say that of burnt magnesium, which is certainly neither volatile nor combustible.

Finally, Dr. Tyndall suggested an ingenious mechanical explanation, that the air was dragged up in convection currents faster than its supported dust, which consequently got left behind; and with this he was content.

So the matter rested until 1881, when Lord Rayleigh re-examined the phenomenon, "not feeling satisfied with the explanation given by the discoverer," and conclusively established the inefficiency not only of all ready-made hypotheses concerning it, but also of those which occurred to himself. A most interesting reversal of the experiment was made by Lord Rayleigh, for, instead of holding a warm body under the beam, he held a cold body above it, and witnessed the formation of a down-streaming dark plane of great sharpness, bordered by bright fringes of extra dusty air, which he attributed to the dew-point being passed, and the consequent condensation of moisture upon dust-nuclei.

Three years ago I took up the subject, and, with the active co-operation of the late Mr. J. W. Clark, then acting as Demonstrator, repeated all known experiments with minute care, in order to find out the cause of the singular phenomenon.

The results of this research are numerous; I can do no more than summarise a few of them to-night, though I believe that some of them, if followed up, would lead to results of considerable interest. The first thing we observed was that the ascending dark plane was the extension and upstreaming of a dust-free coat which invested the surface of the warm body, and which was really the essential part of the phenomenon, the dark plane being merely an upstreaming extension of it. From gently warm bodies the upstreaming dark plane, being made by the uniting of two coats, one from either side of the body, is easier to see than the coats themselves, but they are usually quite distinct, and on the average may be taken as about the hundredth of an inch thick.

Appearance of Coat and Plane shown by Diagram

(Figs. 1 and 1A).—Round red-hot bodies the coat is obtrusively evident. We first observed the coat on the concave side of a hemi-cylinder of sheet copper. We tried this shape in order to disprove Lord Rayleigh's suggested explanation that the dust-freeness might be due to the curvature of the stream-lines

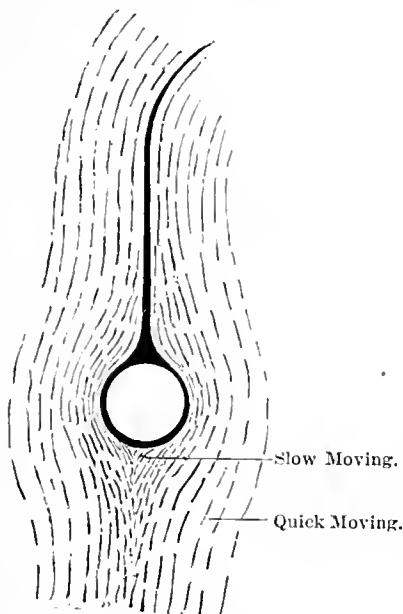


FIG. 1.

and centrifugal force. This idea it does disprove most effectively, for the curvature being negative on the inside of the cylinder, dust ought to be thrown towards the body, instead of being kept well away from it, as in fact it is (Fig. 2).

Lantern Slide of Planes.—It is not easy to project the actual dark coat and plane on to a screen, because the light from the dust particles is but feeble; but it is possible to send a beam along the rod, instead of



FIG. 1A.

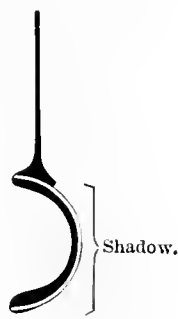


FIG. 2.

across, and to show that the dust-free space is more transparent than the surrounding smoky air. In this way a projection of thick coat and plane, in light, upon the screen, is easily made.

Experiment.—A platinum wire a few inches long is stretched across a glass box, and arranged to be pulled straight at all temperatures. A parallel beam is sent exactly along the wire, and through a lens, the box is filled with brown paper smoke, and a few Grove cells applied.

In trying this experiment one often finds a copy of the appearance imprinted upon the glass wall of

the box in smoke, and this dust-graph also serves to illustrate the phenomenon.

[Projection on screen of dust-graph formed on a vertical glass plate, where the end of a hot rod is held against it in still dusty air.]

It may be convenient here to state, at least roughly, the line of explanation to which we have ultimately been compelled. We regard it as quite certain that the facts serve as another illustration of the kinetic theory of gases, of the same kind as Mr. Crookes's radiometer. The dust particles are kept out of contact with the warm body by means of a differential molecular bombardment on their surfaces. True, the thickness of the coat is far larger than the mean free path of a molecule at the corresponding pressure; and accordingly no body as big as a radiometer vane could at that distance be acted upon; but Professor Osborne Reynolds has shown that very minute bodies are susceptible to a bombardment at much greater distances; and it is, I think, in accord with his theory that dust particles should be repelled from hot bodies over a measurable distance even at ordinary atmospheric pressure, although radiometer vanes would only be acted upon at a pressure of a thousandth, or something approaching a millionth, of an atmosphere. I do not say that this explanation is yet complete, and I am not aware that anyone has adopted it. It is, however, pretty clear that there will be an outward pressure from the surface of a hot body,* so long as the air near it is getting warmer; and if convection currents are allowed, the air near a hot body is continually in the state of getting warmer.

The main facts which we assured ourselves of may be thus briefly summarised.

1. The dark plane becomes visible over a cylindrical thermometer bulb indicating a temperature only half a degree warmer than the air.
2. The dark coat becomes just visible round a body one degree hotter than the air; at two degrees it is distinct; and at five degrees it is fairly thick.
3. The coat enlarges with diminished pressure, and narrows when the pressure is increased.
4. In hydrogen the coat is thicker, and in carbonic acid thinner, than in air.
5. If volatile smoke like volatilised camphor is used, the coats become thicker, though less sharply defined.
6. Round a rod of camphor in ordinary smoke the dust-free coat is extra thick, owing to the extra bombardment of evaporation.
7. Round cold bodies the coat is practically absent, especially on the top of the body; and if the cold is too great no descending dark plane is formed: only a bright one.
8. Liquids containing solid powder in suspension (e.g., dried ferric oxide in water) form a very narrow dark plane over a moderately warm cylinder. But the thickness of the plane is so slight that it is difficult to observe, and it gets thinner with increase of temperature, instead of thicker, as in the case of gases; hence the experimental rod in a liquid must be only gently warmed.

The formation of a descending dark plane in dusty air below a moderately cool body is singular, for it would not naturally have been expected on the bombardment hypothesis. The dust particles must be driven towards, instead of away from, a cold body; and this fact is obtrusively evident, from the fact that such a body becomes quickly covered with soot

* See for instance some experiments of Mr. Crookes on repulsion by hot surfaces, described in *Nature*, vol. xv. page 301.

in an atmosphere of MgO or other smoke, while a warm body remains clear.

It is easy to illustrate this fact by two black conical flasks, one full of hot water, the other of cold, both put under a bell-jar of thick white smoke. In about five minutes, if they be taken out, it will be found that the hot one is nearly free from soot, the cold one covered as with hoar-frost.

Mr. Aitken, of Edinburgh, has also observed this fact, and has pointed out that it explains the deposition of soot in chimneys, and of lampblack on cold glass. Mr. Aitken's paper in the Transactions of the Royal Society of Edinburgh for 1884, is a most comprehensive and lucid account of all this part of the subject. His work was concurrent with ours, as related in the "Philosophical Magazine" for 1884, and it is better described.

Bodies colder than the air in contact with them have the dust in it bombarded on to them; as is well seen on a wall above hot-water pipes, or on a ceiling above a gas-jet. Smoking of the gas-jet will of course provide more material to be deposited, but the dust and smoke naturally (or unnaturally) in the air are usually ample to effect a sufficient blackening, over even a perfectly clear flame. An incandescent electric lamp hung a foot or so under a white ceiling will similarly cause a small black patch.

In rooms warmed by radiation (open fire or sunlight), objects are warmer than the air and keep much dust off themselves; though the bombardment may not be sufficiently vigorous to overcome the gravitation of the larger dust particles, especially over a flat horizontal surface, where convection is sluggish.

In stove-heated rooms things are liable to be colder than the air, and thus get exceedingly dusty.

The cause of the clearing of smoky air inside a bell-jar by the introduction of a hot platinum wire, or other hot body, as observed by Tyndall, who called it calcining of the dust, is now manifest: the dust is bombarded on to the sides and floor of the vessel by the warmed air. The self-formed picture of dark coat and plane formed on a glass surface when the end of a hot cylinder is held against it is similarly completely explicable.

But, it may be asked, if dust gets driven towards cold bodies instead of away from them, how is it that any dark or dust-free plane forms beneath them? At very low temperatures I believe it does not, but rather a bright or dusty layer forms instead. From a rod a few degrees below the air a fine dark plane is visible, however, edged by two bright ones. I do not know what Lord Rayleigh's view of this descending plane is, but it may be due to the gravitative settling of the dust through the air immediately beneath the cold body; a thing which is shown to occur by the existence of a thin dark half-coat formed underneath, but not above, such a rod, and by the deposit of dust on its upper surface. The rod shelters the air immediately beneath it from the shower, and so a layer of clear air forms and streams downward continuously. If the downward convection currents are too rapid the settling has not time to occur, and no dark plane is visible.

The original plan of experiment included a series of measurements of the thickness of the dark coat at different temperatures (both excess and absolute), at different pressures, and in different kinds of gas. This research Mr. Clark had indeed begun to arrange for, but his untimely death last year cut short this part of the investigation. Another very necessary thing is to see how it varies with size of dust particles. Meanwhile I had devoted myself to developing a branch of the subject which we had accidentally hit upon in the course of testing one hypothesis which had at an early stage occurred to us

as perhaps a clue to the cause of the phenomenon of the dust-free plane. We thought it possible that air in streaming over the surface of the solid might get electrified, and that, from air so electrified, dust might somehow be expelled. To test this hypothesis, we purposely electrified the rod, positively and negatively, to see what happened. A hundred volts or two produced a barely noticeable effect; positive electrification causing a slight widening, negative electrification a slight narrowing of the dust-free coat. But as soon as the potential rose to a few thousand volts, and brush discharge began to be possible, a very violent and remarkable effect was noticed: the dark coat widened enormously and tumultuously, and the whole box was rapidly cleared of smoke.

To specially observe this new phenomenon is very easy. Fill a bell-jar with any kind of smoke: tobacco, camphor, turpentine, magnesia, ammoniac chloride, ammoniac sulphite, brown paper, steam, phosphoric oxide, lead fume, zinc fume, no matter what, and then discharge electricity into it from a point connected with a Voss or Wimshurst machine, the other pole of which is connected with the ground or with the base of the bell-jar.

In a second or two, aggregation of the smoke particles sets in, they form in masses or flakes along the lines of force, and in another instant the jar is clear of smoke; it has all been condensed on the sides and floor of the vessel.* [Experiment.]

The kind of smoke used is quite immaterial, it is all acted upon in the same way, but to make the effect visible to an audience; it is better to use something which does not dirty or render opaque the glass. Burning magnesium ribbon makes a very good and clean smoke. For experiments on a large scale a cheap smoke is obtained by burning sulphur in the neighbourhood of a pan of ammonia. Whether positive or negative electricity be used seems to make no difference.

Instead of a single point, a double set of points may be used, each connected with one pole of the machine. A round knob will act instead of a point, but not so quickly. Brush discharge, or anything that electrifies the air itself, is the most effectual. When a knob or pair of knobs is used, the lines of force are interestingly mapped out by the dust-flakes.

The cause of the phenomenon is manifest enough. The electrified or polarised particles attract each other, and are attracted by the opposite poles, just as iron filings are influenced near a magnet.

In thinking over what manifestations of this aggregating power of electricity were already known, the beautiful observations of Lord Rayleigh on water-jets occurred to me; though the cause in this case is not so clear. The experiment is not so well known as it should be, and, being an extremely simple one, I venture now to show it. A vertical water-jet two feet high, from an opening $\frac{1}{8}$ inch in diameter, scatters into drops and falls as a shower of rain; but hold a piece of rubbed sealing wax a yard or so distant from the place where the jet breaks into drops, and they at once cease to scatter; they fall in large blobs as a thunder-shower.

[Experiment. The rain may be allowed to patter on to paper, when the difference in sound is very distinct. The air should be free from electricity beforehand, as the jet is extremely sensitive.]

Clouds can probably be caused to rain by discharging electricity into them; at any rate a cloud

* Note added July, 1886.—My attention has just been drawn to a paragraph in "The Mechanics Magazine" for November, 1850, wherein it appears that this phenomenon was at that time observed by a Mr. C. F. Guitard; a fact of which I had been quite ignorant.

of steam in a bell-jar rapidly turns into Scotch mist or fine rain, and so disappears.

[Experiment. Insulation in this case is a slight difficulty, but it is easily managed.]

To make a thick mist or fog it is sufficient to introduce a scrap of burning sulphur under the bell-jar; instantly the country mist becomes more like a town fog, but this also is rapidly dispersed by electricity. [Experiment.]

I have ventured to think it possible that the coagulation or combination of oppositely charged dust particles is a gross imitation of the cohering of oppositely charged atoms in a chemical compound. When nitrogen and hydrogen are subjected to sparks they unite gradually into ammonia. When a brush discharge passes into oxygen it aggregates into ozone, as is well known from the smell near an electrical machine in action. Such actions (especially the latter) do seem to me of the same nature as the aggregation of charged smoke particles, though far more refined. The size of a smoke particle is not great, but it is enormous compared with an atom. Each granule of a lycopodium cloud may be taken as containing pretty exactly one trillion molecules. A smoke particle is a good deal smaller than a lycopodium granule, but not incomparably smaller. It is because of the minuteness and the interleaved arrangement of oppositely charged atoms in a compound, that its electrical capacity is so enormous; so that ten billion units of each kind of electricity can be stowed away among the atoms of a milligram of water, without raising the potential of each above a volt or two.*

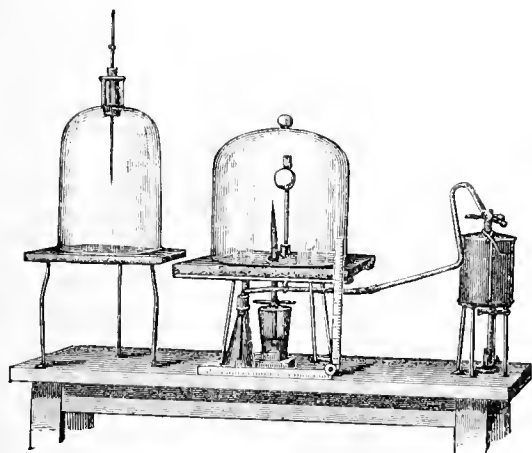


FIG. 3.

Two bell-jars as used for smoke and fog condensation in lecture experiments. The one with the point let in at top is for any dry smoke; the other is for any damp or acid smoke. Insulation is in this latter case quite outside the chamber, and the rod, swathed in glass or gutta-percha, enters through a wide hole in the base-board. The little flask is only to catch drip. The ivory ball is to be illuminated by a beam of light, and to shine through the fog as it clears.

APPLICATION OF THE COAGULATING POWER OF ELECTRICITY TO PRACTICAL PURPOSES.

In many industries the presence of fine dust or fume suspended in the atmosphere is highly objectionable, sometimes because of the poisonous or dangerous nature of the dust, sometimes because it is valuable and apt to escape and be wasted.

* In connection with this part of the subject, see British Association Report for 1885 (Aberdeen), page 744, where an electrostatic theory of chemistry is discussed.

In flour mills and coal mines the fine dust is dangerously explosive. In lead, copper, and arsenic works it is both poisonous and valuable.

Mr. Alfred Walker, of Walker, Parker & Co., first informed me of the difficulty which lead smelters labour under in condensing the fume which escapes along with the smoke from red-lead smelting furnaces, and he wished to put an electrical process of condensation to the test on a large scale.

The devices which are in use at different works to collect or condense this fume are very numerous, and some of them very cumbersome.

At Bagillt the method used is a large flue two miles long, coiled up in the side of a hill between the furnace and the chimney; much is retained in this flue, but still a visible cloud of white lead fume continually escapes from the top of the chimney.

The only difficulty in the way of depositing fume in the flue by means of a sufficient discharge of electricity, is the violent draught which is liable to exist there, and which would blow away mechanically any deposited dust. In some ways the blast may be helpful, for instance by keeping the electrical points clear and preventing local clogging; but a large chamber must be provided somewhere for the coagulated flakes of dust to settle and remain in calm.

The plan I suggest at present is to line a certain portion of the interior of a flue with spikes, and then to hang in the middle of it wire netting, *well insulated*, and studded all over with ragged edges and points. It may be suspended lengthways in the flue. If the chamber be very large, it may be well to have a number of long prickly nets, arranged parallel to each other, and kept alternately positive and negative.

The insulation of the suspended conductor, whatever its shape, has, of course, most carefully to be arranged; everything depends upon that.

[Experiment showing the action of an electrical point held above a model chimney emitting smoke. Its first effect is to destroy or reverse the draught; but if the chimney be itself provided with points at the top, and an electrified cap be held over it—*e.g.*, a small sheet of prickly wire gauze, the draught is assisted, and the smoke is mainly condensed.]

I do not regard this as a good method of dealing with smoky chimneys. The right way to deal with them is to abolish them—*i.e.*, to make combustion so perfect that no unburnt matter escapes.

The experiment illustrates, however, that smoke can be caught and deposited on the wing.

[Special apparatus for producing and condensing quantities of smoke was next shown in action. It could be kept electrified by a small Voss machine. After a lecture in London I had an opportunity of trying Mr. Wimshurst's 8-plate machine on the smoke chamber, and the rapidity with which it was cleared was surprising. Roughly speaking it might be called instantaneous.]

When such a machine as this of Mr. Wimshurst's comes to be used, one may hope to make an impression on fume produced on a manufacturing scale. But further data in this direction are desirable.

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Engineering, 21st May, 1886, Wimshurst.

La Nature, or *Electrician*, 21st May, 1886, Tissandier.

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J. Carter-Bell, Bankfield, The Cliff, Higher Broughton, Manchester.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Opening Meeting, 2nd November, 1886.

SIR HENRY E. ROSCOE, M.P., F.R.S., IN THE CHAIR.

CHAIRMAN'S ADDRESS.

THE CHAIRMAN : It is a pleasure to me to be able to be amongst you this evening to open the Fourth Session of our Manchester Section of the Society of Chemical Industry, and I must first ask your kind attention to some remarks of a personal char-

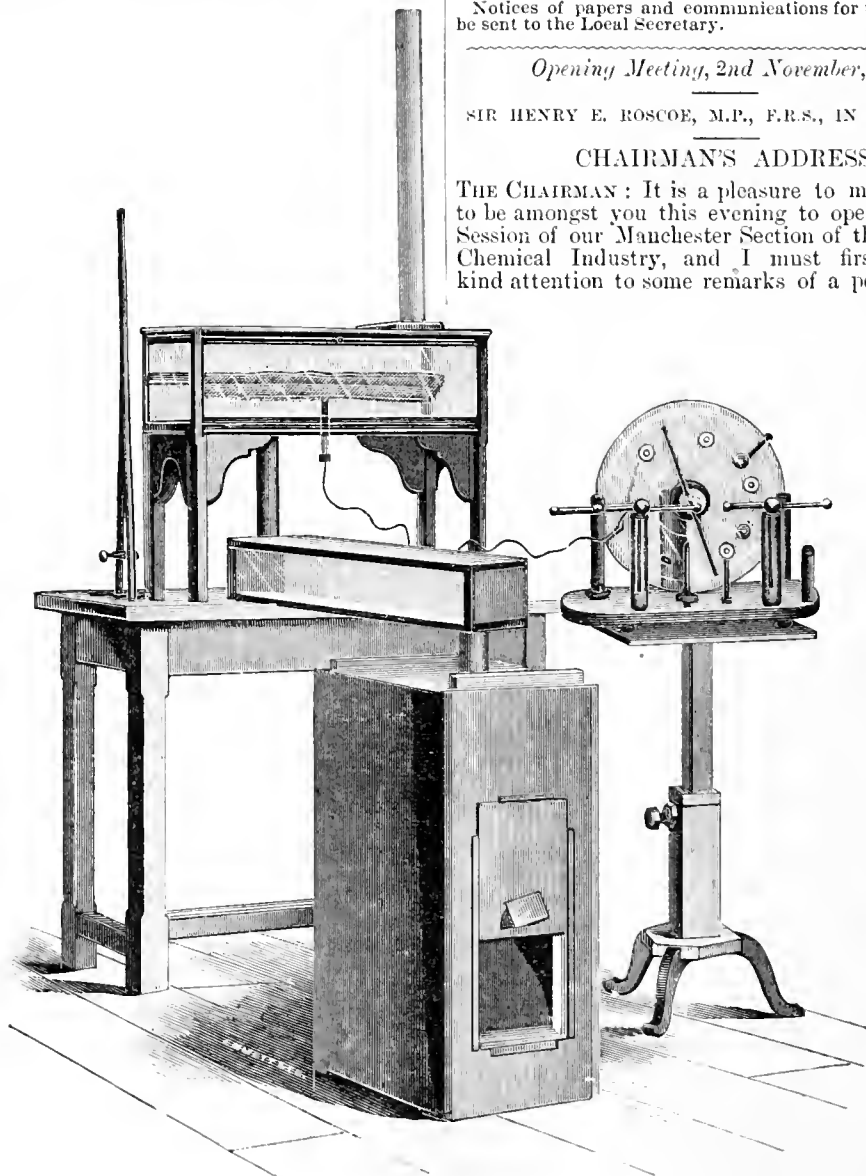


FIG. 4.

Nature, xv. p. 302 (1877), Crookes (Repulsion by Hot Surface).

Phil. Trans. 1879, ii. p. 727, Osborne Reynolds (Dimensional Properties of Gases).

Proc. Roy. Soc. March and May, 1879, and June, 1882, Lord Rayleigh (Liquid Jets).

Brit. Assoc. Report, 1885, pp. 744 *et seq.*, Lodge (Electrostatic View of Chemical Action).

acter. I desire to thank the members of this Section and other gentlemen, members of firms in Manchester connected with our chemical industries, for their kindness in presenting, as they recently did, a memorial to the Council of the Owens College, asking that I should continue in some position connected with that institution. I appreciate the confidence thus shown in me. The terms in which

the memorial is couched are too flattering, but I must say that the expressions are not stronger than my desires have been. I have always felt that in this district, where chemical industry occupies so important a place, it is important that the industry should be united with and founded upon science, and the efforts which I have made in co-operation with my colleagues, who have so nobly assisted me in the tuition at the College, have always been in this direction. That the efforts thus put forth have not been wholly unavailing is shown by the very considerable number of our pupils who now occupy positions of trust and importance in the chemical establishments of this district. I need scarcely add that it is with great regret that I find my labours, for nearly thirty years as a teacher of chemistry in this great district, drawing to a close, and I assure you, gentlemen, and my other friends in this city, that my interest in the maintenance of this union of science and practice is, and will remain, as great as ever. It will always be a pleasure, as well as a duty, for me to assist the cause of scientific education here and elsewhere; indeed, it is the confident hope that I may be able to do something in this direction for our common country that has induced me to make, what is to me, a considerable sacrifice in entering public life. Again, I beg heartily to thank all the friends who signed the memorial. I think I may congratulate the Society on what appears to be an improvement in the general trade of the district. I don't know whether that improvement has as yet reached the chemical industries, but I cannot help thinking it will do so soon. In connection with this matter I wish to bring under your notice a subject which I think of great importance to the chemical industries of this district. I refer, as you will easily understand, to the proposed Manchester Jubilee Exhibition. I wish to refer specially to Section III., which is set apart for chemical and allied industries. The worthy vice-chairman of our Society, Mr. Ivan Levinstein, is chairman of the committee, and a more active, painstaking head of a committee of that kind could not have been found. Associated with Mr. Levinstein are many distinguished gentlemen interested in chemistry and its applications. The intention of the committee, I understand, is to have an exhibition of chemical products, chemical apparatus, and chemical processes such as, for extent and perfection of arrangement, has never yet been witnessed. The different stages of manufacture, from the raw material to the finished article, will be carefully shown. I hope the Manchester industrial chemists will put their best foot foremost and assist the Exhibition authorities to show the great strides that have been made by the chemical manufactures of this district during the last fifty years. Some idea of the extent of the section of the Exhibition in which they are particularly interested, may be formed from the fact that the space set apart for it is 48,000 square feet. The section has been divided into seventeen classes, and if a good representation of the various classes can be secured, the Exhibition will be a better one than has ever been seen before. I hope the members of the Society will do what they can to make the Exhibition second to none that has yet been held. Looking at the matter from a pounds, shillings, and pence point of view, I think it will be worth your while to take the matter in hand.

The CHAIRMAN concluded his address with a short description of the Chemical Institute recently built at Zurich at the cost of £70,000, in order to show what might be done in England if the people had the same views as people on the Continent with regard to the applications of science.

NOTES ON A FEW CHEMICAL SUBSTANCES RECENTLY INTRODUCED INTO THE FIELD OF CHEMICAL INDUSTRY.

BY IVAN LEVINSTEIN.

ONE of the principal objects of our Society is that of keeping its members posted up in the progress which is being made, not only in scientific, but more especially in industrial chemistry. With this object in view I desire to direct your attention to the following chemical compounds—viz., salol, lanolin, and antifebrin, which have lately become of industrial and also of medicinal importance.

Commencing with salol—the new antirheumatic *par excellence*—I may just state that I am aware that attention has already been called to it by Mr. Moss, in a paper read before the British Pharmaceutical Conference, held on September 1; that gentleman was, however, under the erroneous impression that the process of its manufacture was a secret, and was not aware that it was the subject of a patent; and this fact will serve as a justification for further referring to this very interesting and valuable substance.

Salol was produced about three years ago, by Professor Nencki, who also investigated its physiological properties. To Dr. H. Sahli, however, is due the credit of having first practically applied it to medicinal purposes; and the results which he obtained were made public by him in the early part of the present year, in a communication to the Société de Médecine et de Pharmacie, at Berne. Nencki and von Heyden's successors patented the process of the industrial manufacture of salol in Germany, England, and other countries about three or four months ago, and transferred the right of manufacture to three continental firms—viz., Messrs. Durand & Huguenin, of Basel; Dr. von Heyden's successors, of Dresden; and E. Schering, of Berlin. The complete specification of the British patent, No. 8018, 1886, has not been filed, and no copy of it is obtainable, while the German specification has not yet been printed. According to the inventors, there are within their knowledge three modes of practically effecting the industrial production of salol—viz.,

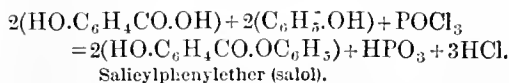
1. Heating salicylic acid and phenol or naphthol with phosphorus pentachloride or phosphorus oxychloride.

2. Melting the sodium or other metallic compounds of the salicylic acid and phenol or naphthol together, with phosphorus pentachloride or phosphorus oxychloride.

3. Treating with phosphorus pentachloride or phosphorus oxychloride the crude product of the reaction obtained in the manufacture of salicylic acid.

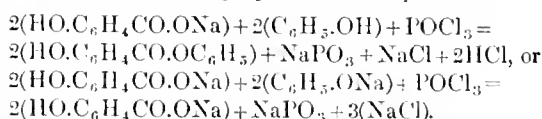
This last mode is probably the most likely to produce the most economical results. The general reaction may be stated to be as follows:—

When fatty or aromatic acids are heated with phenol or naphthol in presence of a dehydrating agent, such for instance, as phosphorus oxychloride, acid ethers are formed. Thus, if molecular quantities of salicylic acid and phenol are melted together, and this mass heated with phosphorus oxychloride, at from 120° to 130° C., the salicylic phenol ether or phenol salicylate, "salol," $\text{HO.C}_6\text{H}_4\text{CO.O.C}_6\text{H}_5$, is obtained.



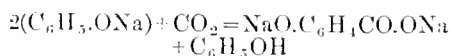
Under the same conditions the resorcinol salicylic ether may be obtained, if the phenol is replaced by resorcinol.

The reaction is effected in a simpler manner, and gives a better yield if in place of free salicylic acid and phenol their sodium or other metallic salts are used, as the following equation will explain :—

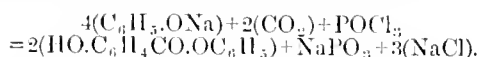


Instead of phosphorus oxychloride, phosphorus pentachloride may be substituted.

In place, however, of commencing with free salicylic acid, the salicylphenylether (salol) may be produced by taking the crude product of reaction, as obtained in the process of manufacturing salicylic acid according to the following formula :—



This mixture, after being allowed to cool, is treated either with phosphorus oxychloride or phosphorus pentachloride, when the process may be explained by the following equation :—



Finally, the process may be effected by first heating for some time in closed vessels a mixture of phenol carbonate, sodium hydrate, and phenol at 180° to 200° , allowing it to cool a little, and then treating the mass as above described with phosphorus oxychloride or phosphorus pentachloride.

The information available with regard to salol is naturally scanty, as the article itself is comparatively of recent origin, and its manufacture was only commenced within the last few months. All that has been published is more or less an abstract of the communication of Dr. Sahli, who, however, chiefly confined himself to its therapeutic properties. Dr. Sahli's experiments thus far go to prove that salol is a valuable antiseptic antipyretic and antirheumatic. He especially remarks on its great efficacy in rheumatism, and on this point I can confirm his far greater experience by a single instance which happened to fall under my personal observation. A friend had been suffering for a lengthened period, extending over several years, from chronic rheumatism of the joints; and after having spent more than three months of the present year at the best anti-rheumatic watering places on the Continent, returned without having derived the benefit desired. On the contrary, the pains increased, and also the swelling of the knee and finger joints. Having read Dr. Sahli's paper, I induced my friend to try salol, and its beneficial effect on him has certainly been most striking. In the course of a few days the pains were relieved, and the swellings subsided immediately. My friend then discontinued the use of the salol, but was again inconvenienced by the damp and wet weather of the early portion of last month; he again took the salol with equally satisfactory results, and though it has not yet entirely removed his chronic rheumatism of old standing, he is at least in the fortunate position of possessing a remedy which will afford almost immediate relief from pain, and at once reduce the swelling of the joints. The possession of such a remedy is undoubtedly a great boon in this damp climate, so unfavorable for the cure of rheumatism. I may add that my friend had repeatedly tried salicylic acid, but had in every case been compelled to discontinue its use owing to the disturbance of the digestive functions which this remedy unfortunately produces with most persons

Now salol is practically free from this very great disadvantage, and under ordinary circumstances may be taken for weeks twice or thrice daily in doses of thirty grains, without producing any perceptible effect on the digestive organs. As Professor Nencki has shown, salol, being insoluble, passes unaltered through the stomach, and is only decomposed into salicylic acid and phenol in the duodenum by the ferments of the pancreas. Its action on the human system is, therefore, like that of salicylic acid and phenol combined, with this remarkable difference, that the latter may be taken in the form of salol without ill effects in larger doses than would be possible if taken alone. Salol is also said to be very effective in neuralgic and other similar complaints. After taking salol, the urine has a similar dark or even black colour to that of carbol urine, but it is singular that this dark colour is not present in all cases, even though comparatively large doses of salol are taken. Sahli attributes the valuable antipyretic properties of salol to some extent to the phenol which it contains, and thinks that this fact also accounts for its action as an antirheumatic, being more powerful than that of salicylic acid. Salol is further recommended as an immediate and very efficient antiseptic, and for surgical operations it may be found of the highest value, as it is neither caustic nor irritating, like phenol and salicylic acid. Dr. Sahli also employs salol as a dentifrice, and considers it to be, perhaps, the only one that will effectually prevent the spread of caries in the teeth. He dissolves salol in alcohol, and adding a small quantity of this solution to water, uses the milky emulsion for rinsing the mouth. His theory is that small particles of the insoluble salol in this finely divided state become lodged in the small crevices of the teeth, and thus act for a certain length of time as an antiseptic. Chemically as well as physically, salol behaves in a similar manner to fats; it is soluble in ether, alcohol and petroleum spirit; crystallises in large and well-developed crystals, and possesses a not disagreeable aromatic smell. Its melting-point is 43°C . The fact of its possessing similar properties to fats, and its solubility in petroleum and other solvents, renders it very suitable for impregnating bandages or preparing salol-wool, as it adheres far more readily than salicylic acid.

I think enough has been said to show that this interesting substance may be destined to play an important part in medicine, in hygiene, and probably in the arts and manufactures. I have to thank Messrs. Durand and Huguenin for the specimen of salol which you have seen this evening, and which represents their commercial and absolutely chemically pure product.

We will now turn our attention to the next chemical substance which will occupy a portion of these fragmentary notes—viz., lanolin.

CHOLESTERIN OR LANOLIN.

Cholesterin, $\text{C}_{26}\text{H}_{44}\text{O} + \text{H}_2\text{O}$, although in a strict sense chemically differing from fats, possesses very similar physical properties. It is present not only in the animal organism but also in the vegetable kingdom. Liebreich has recently demonstrated its presence in the human epidermis, in hair, whalebone, tortoiseshell, hornshavings, feathers of geese, fowls, turkeys and pigeons, bristles of the hedgehog, hoofs and warty excrescences on the leg of the horse, horny substance of the sheep's foot, etc. Until a short time ago, however, the usual material for obtaining cholesterin for scientific purposes was furnished by gall-stones, which consist principally of cholesterin, although many years ago F. Hartmann

and E. Schulze had already found that the fat of greasy wool (wool-grease) contained cholesterol. Indeed, as far back as 1872, Schulze described a method of obtaining cholesterol from wool-grease. He heated the latter for about twenty hours in a closed vessel with alcoholic potash lye at 100°C ., and on drawing off and evaporating the clear hot solution, mixing the residue with water and treating it with ether, he obtained two separate layers,—the watery layer, containing the fatty acids of the wool-grease as potash soaps, and the ethereal layer, holding in solution cholesterol—which, after evaporation was obtained pure by repeated crystallisation of an ether-alcohol solution.

Cholesterol crystallises in thin monoclinic tablets; it has a neutral reaction, being neither alkaline nor acid; it is free from smell and tasteless, insoluble in water, sparingly soluble in cold, but easily soluble in hot alcohol, ether, and chloroform; dissolves also readily in fatty acids; its melting-point is 145°C ., and its specific gravity 1.067.

Professor Liebreich observed that cholesterol fat possesses the peculiar property of being able to absorb more than one hundred per cent. of water, and this singular property was denominated by the great pharmacologist Lanosation, while the cholesterol mixed with water was termed by him lanolin. He also first called attention to the great therapeutic value of lanolin, and shortly afterwards the industrial production of pure lanolin was commenced by a Berlin firm,* and its manufacture has been of late steadily increasing, which is not surprising when we consider the valuable properties possessed by this substance. Indeed, it is impossible to foresee the manifold applications which it may yet find in medicine, arts and manufactures. Lanolin is already taking the place of vaselin, paraffin and lard, and there is every probability that before long it will exclusively replace these substances for medical purposes. Its efficiency in the composition of plasters, salves and ointments has already been established beyond doubt, and its superiority is due to the extraordinary readiness with which it is absorbed by the skin. While vaselin, for instance, directly hinders the passage of medicaments into the skin,—so that even some poisonous substances mixed with vaselin and rubbed into the skin produce neither local nor general symptoms of poisoning,—on the other hand, lanolin is absorbed by the skin with the greatest ease, and this ready absorption is not known to belong in a similar degree to any other fatty substance. So marked is the power of penetrating the epidermis possessed by lanolin that, according to Dr. W. G. Smith, when mixed with poisonous drugs, such as the toxic alkaloids, only about half the usual proportions should be prescribed in ointments. In attempting to account for the ready passage of the lanolin into the skin, Liebreich thought this property might probably be due to the fact of its originating from keratinous tissue. Lanolin may also be advantageously used in place of vaselin in *massage*. It is not so smooth as vaselin, but it possesses this advantage, that the skin, after being rubbed dry with a cloth, still remains soft and pliant; it is further recommended in cases where the epidermis is broken, as, for instance, in chapped hands, and is said to be very serviceable in the treatment of dandruff or scurf. Liebreich, however, warns us against many substances sold under the name of pure wool-oil or wool-grease, which have found their way into trade both before and since the introduction of lanolin.

He considers these injurious, as they contain free acids and various other irritating substances.

Besides the medical uses which have been found for lanolin during the short period of its existence, it has also been already introduced into various branches of industry, such as perfumery, soaps, creams, and pomades, also for greasing leather-belt and for improving the pliability of leather, while quite recently a German officer—Von Kleist—was induced by Liebreich's discovery, that cholesterol is present in the hoof of the horse, as well as in the skin of various animals, to employ it with very successful results as a lubricant for horses' hoofs.

The process employed in the industrial manufacture of lanolin is based on Schulze's method. The crude wool-grease or wool-oil (of which I have here a sample in the bottle marked "II."), is obtained in the usual way by treating the natural greasy wool—specimen I.—with soap liquors, and then decomposing these by mineral acids. According to Jaffé and Darmstädter, the crude wool-oil contains about 70 per cent. (principally cholesterol), and 30 per cent. of fatty acids. The main object of the industrial chemist is to obtain from this mixture the lanolin in a pure state, and this difficulty has been successfully overcome by the two Berlin chemists just referred to, who (according to Liebreich) have succeeded in producing a lanolin of great purity, and to their kindness I am indebted for this collection of samples, showing the different stages of manufacture.

The first operation consists in saponifying the fatty acids of the crude wool-grease by means of caustic soda. An emulsion is thus obtained, which, on dilution with water, gives the so-called wool-milk (specimen III.). When this milk is subjected to centrifugal action, it separates, like cows' milk, into so-called cream and skim-milk. The cream (specimen IV.) contains the lanolin, and on precipitation by a lime-salt, we obtain the crude lanolin (specimen V.). This is heated, when water separates from it, and the lanolin is then further purified from its waxy impurities—higher-melting cholesterol—which are always present in the crude form, by a process which has been patented quite recently. The lanolin is much improved by the removal of these waxy substances, and the product thus obtained is the *Lanolinum anhydricum* (specimen VI.), and this pure anhydrous lanolin is finally converted by being kneaded, with 30 per cent. of water, into *Lanolinum purissimum* (specimen VII.).

In conclusion, I may add that Liebreich, in his investigations, in order to ascertain the presence of lanolin or cholesterol in other fats, made use of the method first described by Liebermann for proving the presence of cholestol, a substance closely allied to cholesterol, which test consists (*Berichte*, 1885, p. 1803) in dissolving the substance to be tested for cholestol or cholesterol in as much acetic acid anhydride as will allow it to remain in solution on cooling, and then adding, drop by drop (cooling at the same time), concentrated sulphuric acid. If cholesterol is present, the solution first turns pink, but soon changes to a fairly permanent blue colour.

The following tests are recommended for ascertaining the purity of commercial lanolin:—

1. If 2–3 grms. of lanolin be put into a small flask with 10cc. of a 30 per cent. solution of caustic soda, and the mixture be heated, red litmus paper placed at the top of the flask must not turn blue—disengagement of ammonia.

2. If 10 parts of lanolin be heated with 50 parts of distilled water in a water-bath, the lanolin must separate as a clear oil. Impure lanolin becomes frothy and turbid.

* Messrs. Jaffé & Darmstädter.

3. If oily, lanolin thus separated must be free from glycerin.

4. If mixed or well rubbed with water on a ground-glass plate with an iron spatula, the result must be a product containing over 100 per cent. of water; and if the lanolin employed is pure, the kneaded mass will be sticky and paste-like; but if impure, the mass will possess a soap-like smoothness, and will not adhere to the spatula.

The last chemical substance, formerly, and till quite recently, a preparation or specimen only figuring in the museum or laboratory of the organic chemist, now an article of chemical industry, is one called "Antifebrin."

Antifebrin or Acetanilide, C_8H_9NO .—It may interest some of our members to inspect the specimen which I have here of the above-named very latest febrifuge. It has been known to chemists for a considerable number of years. Acetanilide is said to be far more effective than quinine in the reduction of fever, and even four times more powerful in its action than antipyrin. As its method of preparation is extremely simple, and the raw materials from which it is made not costly, its price is, of course, very much lower than that of antipyrin. I need scarcely add that antifebrin is made by simply heating for some time aniline and glacial acetic acid, and afterwards distilling the acetanilide.

$NH_2C_6H_5 + HO.CO.CH_3 = N(CO.CH_3)C_6H_5.H + H_2O$.

—This specimen has been made by Messrs. A. Leonhardt & Co.

DISCUSSION.

Mr. WM. THOMSON said that reference was made to the antiseptic and antipyretic properties of salol and antifebrin. There was a general impression that substances which reduced the temperature of the body during fever, such as salicylic acid, were necessarily antiseptics, and that it was due to their antiseptic properties that the temperature of the body during fever was reduced; that is to say, that the antiseptic prevented the rapid development in the blood of the microbes which caused the disease, and consequently the temperature fell. Some time ago he obtained a sample of "antipyrin" which Dr. Leech, of Owens College, informed him had a greater influence in reducing the temperature in fevers than salicylic acid. He tested this substance to ascertain whether it was a powerful antiseptic, and was surprised to find that it possessed little or no action in preventing the growth either of mould or of bacteria. He mentioned this fact to Dr. Leech, who said that he believed the drug acted on the nerve centres in such a way as to more fully open the pores of the skin, the temperature becoming reduced by the more rapid evaporation of the moisture from the surface of the body. Antipyretics were therefore not necessarily antiseptics.



SOME NEW REACTIONS FOR RESORCINOL AND THE RECENTLY DISCOVERED COAL-TAR FEBRIFUGES AND ANTIPYRETICS.

BY WATSON SMITH, F.C.S., F.I.C.,

Lecturer in Chemical Technology in the Victoria University, etc.

DR. EDLEFSEN, in a note in a recent issue of the *Chemiker Zeitung*, describes certain reactions for resorcinol and thalline sulphate or tartrate, and I have tried to discover if any colour reactions are given also with phenol, antipyrine, kairine, "anti-febrine" (acetanilide), α - and β -naphthol,

quinine, and a variety of other bodies, and I find that no reactions are thus given. Hence I concluded that the tests in question would be of very considerable value, and particularly useful in therapeutics, as well as to those of our Society interested in fine chemicals. I have also made one of the tests applicable to cases in which medical men or others may have specimens of "salol," and may desire to know positively if they consist of the phenol- or resorcinol-salicylic ether. My note thus follows not unsuitably the paper of Mr. Levinstein.

Test for Resorcinol.—To a dilute freshly-prepared aqueous solution of the so-called β -naphthaquinone

$C_{10}H_6 < \begin{smallmatrix} CO.CO \\ CH:CH \end{smallmatrix} >$ a few drops of a 1 per cent.

resorcinol solution are added, and then two or three drops of ammonia. The sample at once assumes a beautiful dark bluish-green colour. If a portion of this solution be shaken with ether, little or none of the colour is taken up by the ether. If to the bulk of the green fluid nitric acid be added to acid reaction, the green colour gives place to a fine red, and ether shaken with this solution takes up the red and becomes finely tinted, the lower layer proportionately losing colour, and at length becoming pale yellow or colourless. Chloroform answers as well as ether; the layer, in this case, sinking to the bottom of the vessel. The reaction is specially beautiful if the ethereal solution of β -naphthaquinone be used; α -naphthaquinone does not give the reaction.

Test for Thalline Sulphate or Tartrate.—If to the dilute solution of the β -naphthaquinone, a small quantity of a solution of thalline sulphate or tartrate be added, and then a drop or two of caustic soda solution, a fine red or cherry-red colour is produced, the beauty of which is heightened by acidifying with nitric acid. By shaking the sample with chloroform or ether, they take up the colour and become themselves finely tinted.

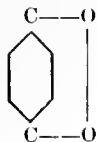
To distinguish a Resorcinol "Salol" from a Phenol "Salol".—Fuse some of the sample with a little pure potash or sodium hydrate in a small silver dish, or boil for some time with a little concentrated alcoholic potash, when the ether is decomposed, and the resorcinol or phenol remains combined with potash. Dissolve in water and pass carbonic acid in excess to decompose the phenol or resorcinol alkaline compounds, and shake with ether. The ethereal solution will contain the phenol or resorcinol, and now the foregoing test may be usefully applied, when, as you have seen, phenol, if present, will give no reaction, only resorcinol giving the beautiful reaction characteristic of it.

Precaution.—Only a dilute solution of β -naphthaquinone must be used, for with a strong one, ammonia will cause a colouration deepening to a tint somewhat similar to that produced by resorcinol. In such case phenol or any other substance would seem to react like resorcinol.

I mentioned that if a too strong solution of β -naphthaquinone is taken, alkali alone would give an immediate greenish colour reaction; I also said that α -naphthaquinone gives no colour reaction under the circumstances referred to. There is no need of surprise at this, for whereas α -naphthaquinone is a true quinone, β -naphthaquinone is a diketone, and years ago Bamberger, Hinsberg and Körner showed that the orthodiketones give colour reactions with alkalis.

Thus—e.g., β -naphthaquinone, $C_{10}H_6 < \begin{smallmatrix} CO.CO \\ CH:CH \end{smallmatrix} >$ and phenanthrenequinone— $\begin{smallmatrix} C_6H_4-CO \\ | \\ C_6H_4-CO \end{smallmatrix}$ are very similar,

whereas α -naphthaquinone is a true quinone, and is constructed on the same pattern as benzoquinone—



and these are both para-compounds, whereas the diketones referred to are ortho-compounds. The antipyratics, kairine and antipyrin, which gave no reaction under the treatment described, can, however, be readily distinguished from the foregoing and from each other by the following reactions, which have been sent me by my friend, Dr. C. A. Kohn, who has been engaged sometime with a study of kairine and its derivatives:—

Commercial Kairine, or the Hydrochloride of Hydroxyhydro-ethylquinoline.—(1) One drop of ferric chloride produces in a dilute aqueous solution a violet colouration, which almost at once changes to brown. Excess of ferric chloride gives a dark brown colouration, and in concentrated solutions a brown-black precipitate. (2) Potassium bichromate when added to a neutral aqueous solution forms a dark colouration at first; after a few seconds or minutes, according to circumstances, a violet colouring matter separates, dissolving in alcohol to a mauve-coloured solution.

Antipyrin (Methyl-pyrazol) $C_{10}H_{10}N_2O$, behaves quite differently from the foregoing. It is distinguished:—(1) By the red colouration produced on addition of ferric chloride. One part in 100,000 can be detected by this reaction. (2) By the pure blue-green colouration produced by nitrous acid in dilute solutions. The colour develops fully after a few seconds. In concentrated solutions green crystals separate. One part in 10,000 can be detected by this test.

"Antifebrin" or *Acetanilide* $C_6H_5.NH(CO.CH_3)$ gives no colour reactions with the foregoing reagents. A small quantity of the substance should be boiled with alcoholic potash, when the following decomposition will take place:— $C_6H_5.NH(CO.CH_3) + KOH = C_6H_5.NH_2 + CH_3.COOK$. The aniline is easily tested in the usual way, and after distilling it off the residue contains potassium acetate, also readily identified.



ON A NEW APPARATUS FOR READILY DETERMINING THE CALORIFIC VALUE OF FUEL OR OTHER ORGANIC SUBSTANCES BY DIRECT COMBUSTION IN OXYGEN.

BY WILLIAM THOMSON, F.R.S. ED.

I HAVE been for some time engaged in the attempt to determine accurately the quantity of heat produced by the combustion of coal, by a simple and convenient process. There are two or three processes which purport to give the heat produced by the combustion of the fuel. The first is that of Berthier, which consists in heating to fusion 1grm. of the coal, with 70grms. of litharge, and 10grms. of oxy-chloride of lead. The weight of the button of lead obtained is certainly a measure, under the conditions of the experiment, of the reducing or deoxidising power of the fuel, and as such, it is no doubt in some cases of much value—such, for instance, as in determining the quality of coal to be employed for reducing the sulphate of soda in the production of black ash; but it is useless as a calorimeter, because an equivalent of hydrogen would be

less efficient as a reducing agent under those conditions than an equivalent of carbon, although when burned in the air the hydrogen would produce more heat than the carbon.

The next simple process is the one devised by Mr. Lewis Thompson, M.R.C.S., which consists in intimately mixing 1grm. of the coal with 22grms. of a mixture of chlorate and nitrate of potash (in the proportion of 3 of the former to one of the latter).

This mixture is placed in a copper tube called a furnace, and fired by a fuse made by soaking a few strands of ordinary lamp wick in a solution of nitrate of potash or lead, and drying. About three-quarters of an inch of fuse is placed upright in the mixture, the tube or furnace containing it being placed in a stand surrounded by four upright brass springs (strips of brass fitted to the stand, and curved upwards and inwards). When the fuse is ignited, a copper cylinder closed at the top, and to which is attached a long narrow tube furnished at the end with a stop-cock, is pushed over the springs; the whole apparatus is then lifted by the narrow copper tube, and immersed in water (about 2000 cubic centimetres), contained in a thick glass cylinder of 13½ in. long by 4½ in. diameter, the temperature of the water being accurately taken before and after the experiments: the difference indicates the heat given to the water and apparatus by the combustion.

The mixture burns away like a squib, often projecting a considerable quantity of the fused mass from the furnace, the hot gases bubbling through the water to which they part with their heat. When the combustion is complete, the stop-cock at the end of the narrow tube is opened to allow the residual gas in the apparatus to escape, and to allow the water to take up the heat still retained by the copper tube, and by the salts left from the combustion.

It is admitted that this process is not an accurate one; still, although the results are rough, it has proved of considerable service in the hands of several eminent chemists.

The method of calculating the quantity of heat produced, as stated by Lewis Thompson, is to add 10 per cent. to the result obtained, for loss of heat by different ways, such as by absorption of the apparatus itself, etc. The amount of heat absorbed by the apparatus may easily be measured, but there is a number of other both losses and increments of heat produced in the apparatus which it would be difficult, if not impossible, to measure, as they would probably vary more or less in each experiment.

When chlorate of potash is heated it dissociates, and in doing so liberates a considerable quantity of heat, so that with the same weight of coal the heat obtained increases in proportion to the increase in the quantity of oxygen or chlorate mixture employed. The nitrate of potash absorbs heat on being dissociated. The oxygen, on being liberated from the solid condition, expands to the ordinary pressure of the air, and absorbs heat, whilst the copper tube or furnace itself liberates heat as it becomes burned, a cake of the oxide of copper being afterwards found both on the outside and on the inside of the tube, whilst the potassium chloride, which is left when the potassium chlorate is decomposed, absorbs a considerable quantity of heat when it comes in contact with, and dissolves in, the water of the calorimeter. The gases also come off so rapidly as to escape being cooled by the water, and carrying much water vapour with them. Lastly, the outside of the glass cylinder is generally uncovered, and so is unprotected from the warmer or colder air around it, and from radiant heat, so that in standing before one of these vessels, in which is placed a delicate thermometer, it may be observed, if the temperature of the water be below that of the

atmosphere, that the mercury goes on rising comparatively rapidly in the thermometer. Lastly, the glass of the cylinder is so thick that it only slowly, if it ever does, come throughout to the temperature of the water inside.

In a communication which I made to the Physical and Mathematical Section of the Philosophical Society relative to the difficulties which I had experienced in working with the Lewis Thompson apparatus, our excellent vice-president, Dr. J. Prescott Joule, suggested the idea to me of burning the fuel in pure oxygen. This was done in the classical researches of Andrews and of Favre and Silbermann, and more lately Gottlieb has made many determinations by an apparatus very similar to that used by Favre and Silbermann; but all these appliances are either costly or complicated, or they are capable of yielding good results only in the hands of the expert manipulator. My first attempts to devise a simple and efficient calorimeter were made by burning the coal in a glass jar

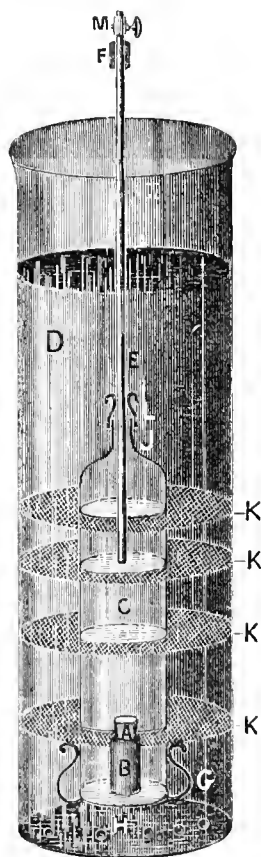


FIG. 1.

previously filled with oxygen in the manner employed by Dr. Andrews. This proved useless in my hands, the combustion, at first rapid, soon became very slow, and ultimately left a considerable residue of unconsumed carbon. In burning pure and simple substances such as hydrogen or carbon, and determining the quantity of material consumed by weighing the products of combustion, which was the method usually adopted by Dr. Andrews, good results could no doubt be obtained, but with such a complicated substance as coal, it is evident that this method would not prove satisfactory. My subsequent attempts were made by placing the fuel in a small glass diving bell,

which was sunk to the bottom of water contained in a thin glass cylinder, the oxygen being conducted by a tube continuously on to the burning fuel. I found it difficult to obtain a steady flow of oxygen, and to obviate this I devised the gas-holder, which I shall describe further on. Various shaped platinum vessels were employed on which to place the coal, the more open vessels or shallow trays exposed the coal too much to the comparatively limited supply of oxygen, so that it gave off its volatile matters so rapidly as to cover the sides of the glass diving bell with a more or less thick deposit of soot. At last I found the combustion could be perfectly performed in a small deep platinum crucible, supported on a non-conducting stand. Fig. 1 shows the apparatus placed in position for making a determination of the heating power of a fuel. A shows the small platinum crucible, $\frac{1}{2}$ inch diameter and $1\frac{1}{2}$ inch deep, resting on the clay support B. I used at first the bowl of a clay tobacco pipe for this purpose. 1 grm. of the fuel is weighed into the crucible, which is then placed on the clay support on the stand H. The inverted test tube C, which is 6 in. long by $1\frac{1}{2}$ in. diameter, has fused to it the small tube J, 1 in. long by $\frac{1}{2}$ in. diameter. Over this is fitted the small piece of black indiarubber tube L, through which passes the long thin copper tube E, about $\frac{1}{2}$ in. internal diameter. This is arranged so that it can be pushed through the indiarubber tube without difficulty, and this is the more easily done by rolling or folding backwards the upper part of the rubber tube on itself. The long thin copper tube terminates in a tap and piece of bent tube, which is placed in communication with the oxygen gas-holder by a piece of indiarubber tubing. The tube C has also attached to it four circles of copper or brass wire gauze K, which fit as accurately as possible into the large thin glass beaker D. The part of the long tube at F is covered with felt or other non-conducting material, so that when the tube is held by it the heat of the hand will not be communicated to the gas passing through it.

The large thin glass beaker is filled with 2000 cc. of water from a supply which has previously been kept in the room in which the experiment is to be made, so that it has come to about the same temperature as the atmosphere. The temperature of the water is accurately noted after being stirred well with a wire or glass plunger, which may be made by bending the wire or glass at right angles to itself, and coiling it round itself so as to form a disc. The thermometer should be fixed in the arm of a retort stand so that both may be removed at once, and so adjusted that the bulb and about two inches of the stem would be immersed in the water of the calorimeter.

When the temperature of the water has been noted, the diving bell C should be arranged with the tube E drawn up to near the top and attached to the supply of oxygen, which should be under slight pressure, with the tap M closed: a fuse of lamp wick similar to that used in the Lewis Thompson apparatus, is placed upright in the coal in the crucible and ignited. The bell glass is now pushed over it, and fixed in position by the springs G, and the whole lifted into the beaker of water and sunk to the bottom; simultaneously with doing so, the tap M is opened gradually and a stream of oxygen passed through the apparatus. The coal burns quietly at first. The thin copper tube should not be pushed far down till all or nearly all the volatile hydrocarbons have been consumed, as for this purpose it is well to have plenty of oxygen in the upper part of the bell glass. When the coke is left in a glowing condition, it is more difficult to burn, and it is advisable then to push the thin copper tube down till the end

is immediately over the platinum crucible. A slight rotating movement can now be given to the tube, so that the gentle stream of oxygen falls on any particles of unburned coke in the bottom of the crucible. So intense is the heat which may be thus produced, that a piece of rather strong perforated platinum foil which I used in one experiment was melted by it. The ash of the coal is left in the form of a number of fused pellets, some very minute, some of considerable size. The bubbles of gas as they pass from the bottom of the bell glass, rise, and are repeatedly broken by the layers of wire gauze *k*, so that they leave the water at the same temperature as the water. When the experiment is completed the taps are closed, and the rubber tube conveying the oxygen detached. The tap on the thin copper tube is now gently opened to allow the water to enter the bell, which is then drawn to the surface and again pushed to the bottom two or three times to thoroughly mix the water in the beaker and to ensure that all

the metallic cylinder, or it may be rested on three sections of a phial cork placed at the bottom of the metallic cylinder.

The oxygen is delivered from the gasholder (Fig. 2), which is filled with that gas by opening the stop-cocks *A* and *B*; after it has been filled with water, the rubber tube *C* is connected with the oxygen generator, and the tube *d* is raised to about the height of the cylinder before the taps are opened. The oxygen enters at *A* and expels the water at *B* by the tube *d*, or by both tubes *e* and *d*. The tube *f* is of glass, and serves to tell the height of the water in the cylinder. The glass tube *g* is attached to the tube *h*, and is open at the top. This serves to indicate the pressure, whilst the rubber tube *e* is used for running out water after the experiment, so as to bring the gas inside to the atmospheric pressure if desired, and thus to enable the operator to measure the amount of gas used for the experiment. In using the calorimeter, the rubber tube *d* is attached to an ordinary tap from the town water supply, so that when the combustion is started the tap *A* is opened full, and the quantity of gas passing through the apparatus accurately adjusted from the town supply tap. The stream of oxygen is thus kept very regular, as the rising of the water in the cylinder makes little difference in the pressure of the water entering.

All the glass, copper, mercury, iron, brass, etc., connected with the calorimeter, are weighed; and from their specific heats their equivalent in water is calculated.

The oxygen employed may be measured, and from its specific heat the quantity of heat carried off may be calculated. The specific heat of oxygen being 0.2160, and of carbonic acid 0.2163, and the weight of oxygen used in each experiment being about 8 or 10 grammes, the correction for the heat thus carried off, especially as the total rise of temperature in each experiment does not exceed from 6 to 8 degrees, is very small. The mean temperature of the gases passing away from the water for each experiment would not exceed three or four degrees of a rise. The water converted into vapour may also be calculated from a table, which gives the quantity of water vapour contained in saturated air at different temperatures. Such a table has been calculated from the observations of Magnus and Regnault, and may be found, p. 316, in Kohlrausch's "Physical Measurements," but, taking the latent heat of water vapour at 965 F. units, the total heat lost, either from evaporation of the water or from that carried off by the air itself, is so small that both together lie within the range of experimental error, half the total rise of temperature being taken for reference to the table.

Lastly, the loss of heat through the apparatus should be taken into account, and as this will vary with the temperature of the surroundings, it is well to take the temperature of the water in the calorimeter immediately after the experiment, and having noted the time which the experiment took to make, notice the loss of heat which takes place during a similar period, and add this on to the temperature of the water. It would, of course, be still more accurate to allow the temperature to fall to somewhere about the mean between the temperature at the beginning and at the end of the experiment, and then notice how much it loses during three or five minutes which were taken to perform the experiment; but I have found the loss at the higher temperature not to exceed an average of about one hundredth of a degree per minute.

It is necessary to find what weight of glass in the thin beaker is in actual contact with the water, and this is done by first weighing the beaker, then

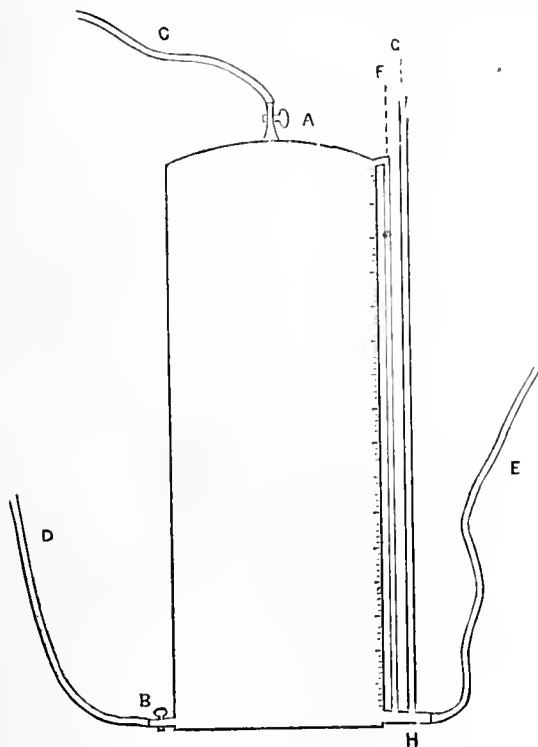


FIG. 2.

the heat has been given up to the water. As the water can only rise in the bell glass to the bottom end of the copper tube through which the residual gas makes its exit, it is well to push it under the water so that it may give up its heat. The whole apparatus is now withdrawn, and the temperature again taken. For the sake of correction the time during which the experiment lasts (generally from 3 to 5 minutes) is noted. When a determination is being made the long beaker containing the water is set in a thin, bright-tinned, silvered, or nickel plated iron or copper vessel, with an opening of about half an inch wide and 9 or 10 inches long, cut down the side, fitted with a glass window, through which the experiment can be observed; the metallic vessel protects the calorimeter from radiated heat and from contact with the colder atmosphere. The calorimeter is suspended in this case by the neck, so that no portion of it, in contact with the water, touches

finding the quantity of water it displaces. This may be easily done by filling a beaker (the size larger than the one intended for use) with water; the one intended for use is now filled with the water from the larger beaker. Some of the water from the larger beaker is also poured into another empty vessel, and the smaller beaker inserted into the larger one. Water is now poured from the vessel above mentioned into the larger beaker till the smaller one is completely covered, and till the water reaches the mark at which it originally stood. The remainder of the water in the vessel into which it was poured shows the total volume of the glass of the beaker.

The smaller beaker is now removed and emptied, and the larger one is again filled with water. The smaller one is now filled to the mark on the glass (2000cc.) with water from the larger. Some more water is again poured into an empty vessel from the larger beaker, which is filled to the mark at which it originally stood, after the smaller one has been sunk into it so that the level of the water inside the smaller beaker is the same as the original mark on the larger one, the excess of water left shows the bulk of glass which would be heated by the water in the calorimeter, and from the total bulk and weight of the smaller beaker, and the water displaced in the second experiment, the actual weight of glass in the calorimeter in actual contact with the 2000cc. of water may be calculated. To obtain the quantity of mercury used in the thermometer the bulb is introduced into a narrow measuring tube and the amount of water which it displaces observed. From this the weight of mercury may be roughly calculated, the weight of mercury being 13.596 times the weight of water displaced. The weight of the two inches of the stem can be calculated by weighing the thermometer and deducting from it the weight of the mercury; the difference will give about the weight of the stem, the length of which is then measured, and the weight of the two inches calculated therefrom. The stirring rod or wire and the long copper tube are weighed and their lengths measured to find the weights actually in contact with the water; the other parts of the apparatus are weighed directly.

The following gives the figures obtained for the apparatus I used:—

MATERIAL USED.	Weight in Grammes.	Specific Heat of Material.	Equivalent to Grammes of Water.
Glass of beaker = 7.812oz.	221.472	.1977	13.784
Glass bell	18.015	.1977	9.192
Brass	106.017	.09391	9.956
Iron	12.993	.11379	1.478
Platinum	7.3496	.03211	.238
Clay support	16.875	.1977	3.336
Indiarubber	1.181	.2	.237
Mercury	27.192	.0333	.905
Thermometer-glass..	1.161	.1977	.822
Copper gauze.....	27.122	.09515	2.531
Water employed	—	—	2000.000
Total material heated in the calorimeter equivalent to water	—	—	2072.829

Calometric valuations by this apparatus can be rapidly performed, and the results obtained agree

very well with each other. The thermometer employed is graduated about half-an-inch to the degree.

DISCUSSION.

Dr. BAILEY: I might suggest to Mr. Thomson that he would still further increase the accuracy of his apparatus by using a larger quantity of water, and if he considers the loss by radiation serious, I cannot see any objection to using a larger quantity of water. I should like to ask whether any allowance is made for the amount of hydrogen in the coal? I would also suggest that the water at the beginning of the experiment should be a little below the temperature of the room, so that it would be a little above that temperature at the close of the experiment.

Mr. GEORGE E. DAVIS: I have used Mr. Lewis Thompson's apparatus very largely for determining roughly the calorific power of many varieties of fuel, from the rich silikstone to ordinary anthracite, and even coke, and have not found so much difficulty in using it as the reader of the paper has made out. I think, however, that Mr. Thomson's apparatus is certainly an improvement, as it enables the operator to regulate the speed of combustion, which is impossible in the case of Mr. Lewis Thompson's apparatus. After all, the employment of either of these forms will only give a comparative idea of the calorific utility—so to speak—of various fuels, and gives no idea whatever of what can be obtained on the large scale, as it does not take into account the physical condition of the fuel, as everyone is well aware that in ordinary furnaces good round coal will always produce better results than small coal or smudge, even if both kinds are identical in chemical composition and give the same results in the laboratory with one of these fuel-testing pieces of apparatus.

Newcastle Section.

Chairman: P. P. Bedson.

Vice-Chairman: J. C. Stevenson, M.P.

Committee:

Alfred Allbusen.
G. T. France.
John Morrison.
F. S. Sewall.
John Pattinson.
J. B. Payne.

H. R. Procter.
B. S. Procter.
W. W. Procter.
W. L. Rennoldson.
C. T. Richardson.
T. W. Stuart.

Local Secretary and Treasurer: J. T. Dunn, 115, Scotswood Road, Newcastle.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Meeting held in the College of Science, Wednesday, November 3.

PROF. P. P. BEDSON, D.S.C., IN THE CHAIR.

CHAIRMAN'S ADDRESS.

AFTER some introductory remarks the speaker then drew attention to certain recent additions to the knowledge of the elementary bodies, making special mention of germanium, and of the recent isolation of fluorine, also of some of the results of Von Welsbach's investigations of certain rare earths; the Welsbach light being cited as a practical outcome of these latter investigations.

An account was next given of the history and mode of manufacture of the febrifuges, kairin, thallin, and antipyrine, obtained from hydrocarbons contained in coal-tar; also of "iodol" or tetra-iodopyrrol, which is manufactured from pyrrol by the process patented by Professor Ciamician and Silber. This compound is of interest as possessing antiseptic properties, and is recommended as a substitute for iodoform. In reviewing matters relating to the alkali industry, mention was made of the recent improvements made

in the plant for the decomposition of ammonium chloride by magnesia, of Dr. Witt's proposal for obtaining hydrochloric acid from ammonium chloride by decomposing it with phosphoric acid; also of the two methods of Messrs. Simpson and Parnell for manufacturing soda. Attention was directed to the important part the dissociation of ammonium compounds plays in these two processes, and after reviewing the history of the investigations of the phenomena of dissociation, and pointing out their importance to the progress of chemical theory, the speaker concluded his address with the following remarks:—But it is not the advantages which the science of chemistry has already gained from the investigations of the phenomena of dissociation that I would speak of, but what is of greater interest is the evidence before us in the proposals of Messrs. Simpson and Parnell, as also in the Claus's process for the purification of coal-gas, described in the August number of the Journal, for the practical application of facts, a knowledge of which has been brought to light by investigations pursued with an object of a purely theoretical interest, and one apparently so remote from the aims of industrial chemistry. Surely facts such as these should serve as a warning to us, and prevent us from assuming toward the theoretical side of the science of chemistry, either the useless attitude of indifference or the impractical attitude of the practical man, or again the attitude of cynicism, finding expression for itself in words akin to those of Mephistopheles to the student: "Grau, theurer Freund ist alle Theorie und grün des Lebens Goldner Baum." For whether we turn to the investigations of rare earths, or to the study of organic chemistry, or the examination of laws relating to the constitution of compounds, we find each contributing its share of facts, which, sooner or later, find an application in some industrial pursuit. Again, in considering what should form the best training for those upon whom will devolve the duty of carrying on the manufactures of this country, we should not only remember the advantages that have accrued to practical pursuits from purely theoretical investigations, and formulate a system accordingly, but remember also these advantages have resulted not from inquiries undertaken with a view to their practical application. Then I think we shall give the theoretical training its true position in our system of education, nor begrudge the time and expenditure that such an education requires. And taking a lesson from Germany, we shall bestir ourselves to promote the extension of Universities similar to those existing in that country, which the various States have spared no effort to equip fully and completely for their work in all branches of knowledge. To the laboratories of these institutions the chemical manufacturers look for chemists to carry on the various industries, and we have it on the authority of Dr. Perkin, that the students from these laboratories find greater favour with the manufacturer than those from the avowedly more practical institution, the Polytechnicum. The universities have also promoted the intellectual activity of the German people, and have, as Professor Beyer has pointed out—in a speech quoted by Mr. Levinstein at a recent meeting of the Manchester Section—in this manner contributed to place Germany in an industrial position superior to that occupied by France and our own country, whose natural resources are superior to hers.

Remembering these facts, also, we shall be the more ready to assign a more honoured position to the theoretical side of the science of chemistry in relation to manufactures. Not looking to its growth and development merely for the provision of methods and

instruments for testing the efficiency of well-established processes and the like, but rather, by making provision for the prosecution of scientific investigations in connection with these manufactures, contribute to the advancement of knowledge, and give to these industries that elasticity and versatility, and resourcefulness in meeting demands for variety in products and commodities, which has been the main characteristic in the growth and development of the coal-tar industry in Germany.

In conclusion, the Chairman said that he should like to say a word with respect to the position of this Section in relation to the other Sections of the Society of Chemical Industry. It was a matter which had already been mentioned in the Committee's Report, and which is of such importance that he could but refer to it once more. He need scarcely say that he referred to the most striking feature in that report—viz., the great falling off in the number of communications brought before the Section during its last session. The majority have been in the form of short notes merely, and one-third of the communications come from a foreign source. He would not emphasise this latter fact, for science recognised no nationality, but this, together with the small number of communications, would appear to denote a want of activity, if not of interest, in the objects for which this Society was formed. He trusted that the proceedings of the coming session would prove that this lack to which reference had been made, represented but a temporary lull, and that the Section would take a position which, for activity and spirit, would worthily sustain its reputation amongst the different sections of the Society of Chemical Industry.

DISCUSSION ON MR. SISSON'S PAPER ON "MAGNESIUM SULPHYDRATE."*

THE CHAIRMAN stated that he had used the sulphhydrate as a source of hydrogen sulphide; he had found the gas quite pure, and thought the method of obtaining it had great advantages over the ordinary method with ferrous sulphide. He thought the cost of the solution rather prohibitory. He would like to know whether the decomposition was complete, and also whether any experiments had been tried as to the solubility of hydrogen sulphide in the solution, at the ordinary pressure and under compression.

MR. B. S. PROCTOR inquired as to the keeping properties of the solution.

MR. CLAGUE thought that the solution would probably commend itself for use in the preparation of sulphur baths. It would seem much more convenient than the ordinary method, and would probably produce a much better imitation of natural sulphur springs.

MR. SISSON stated that the solution gave up a great part of its gas on merely heating to boiling, but to expel the gas completely required a good deal of boiling. The solution would keep for any length of time in closed bottles. He did not know whether it would absorb hydrogen sulphide or not.

A NEW FORM OF APPARATUS FOR COLOUR TESTS, AND NOTES ON STEAD'S ALKALI METHOD FOR ESTIMATING LOW PERCENTAGES OF CARBON.

BY C. H. RIDSDALE, F.C.S.

At the spring meeting of the Iron and Steel Institute in 1883, Mr. Stead read a paper on "The Estimation

* See April number of this Journal, p. 210.

of Minute Quantities of Carbon in Iron and Steel, and a new form of a Chromometer." He described a method for dissolving the combined carbon in an alkali, and estimating the percentage of it from the relative height of two columns of liquid required to give the same depth of tint, one being a solution of a steel containing a known amount.

At the North-Eastern Steel Works we have very often occasion to test rapidly steels containing under '09 carbon, and sometimes as low as '02 per cent.

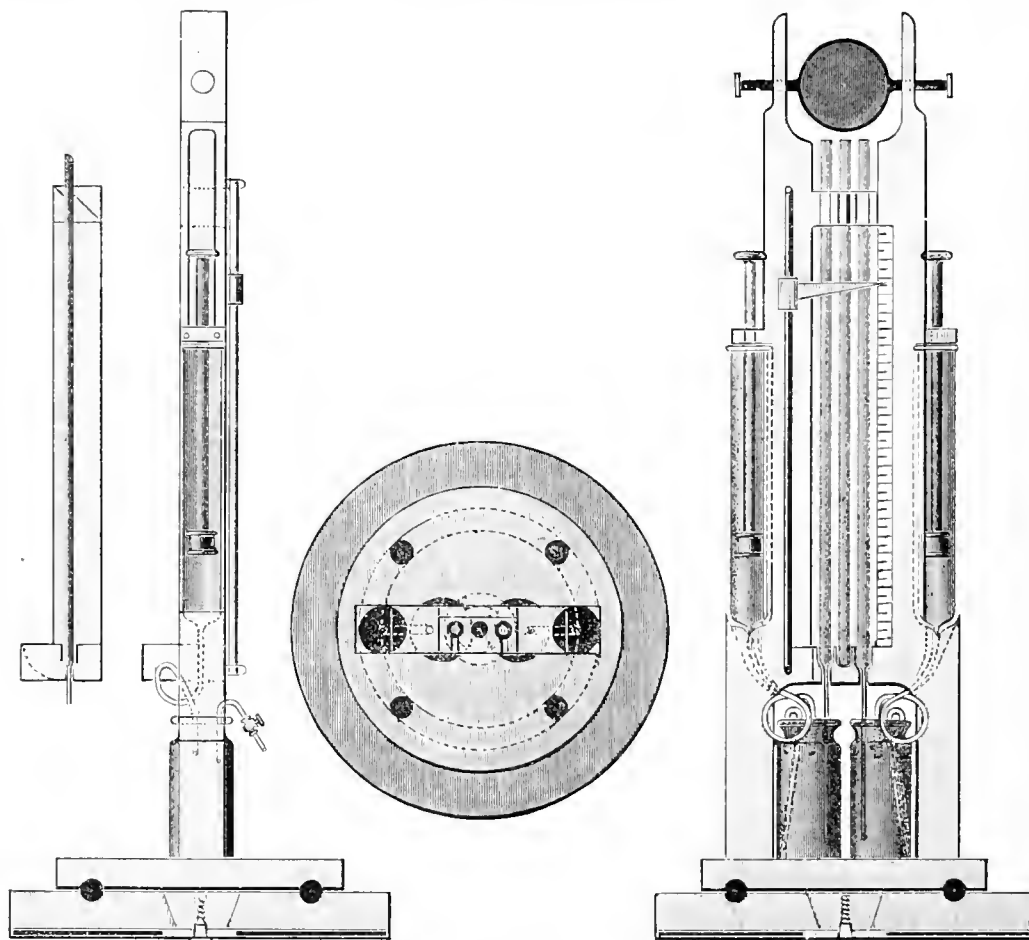
It was out of the question to use the combustion process, being much too slow for practical working, and on the other hand the ordinary Eggertz colour test was unavailable, as it was incapable of showing any difference when the carbon content was below '07

of CO_2 obtained, causes a large difference in the percentage.

On a 10grm. portion by combustion, 1milligram. of CO_2 represents a difference of '0027 per cent.

On a 1grm. portion by the alkali method, one division on the scale (which makes a marked difference in the depth of tint) represents with a '05 C. standard, '0025 per cent, or barely as much as 1milligram. on a 10grm. portion by combustion, and it is considerably easier to work to one division by the colour method, than to 1milligram. by combustion.

Mr. Stead's method, as published, is as follows:— Dissolve 1grm. of the sample in 12cc. nitric acid, of sp. gr. 1'20; heat to 90° or 100°C . till the sample is dissolved, which will take about 10 minutes. Then



RIDSDALE'S ROTARY CHROMOMETER.

per cent. We, therefore, at once adopted Mr. Stead's method, and found it to answer very well indeed, the results being both rapid and accurate.

As regards *rapidity*, we regularly test one blow before the next but one is brought in, the average time for the analysis being 35 to 40 minutes, and the time from the taking of the sample of molten steel to the sending out of the result, being under the hour, which is obviously very desirable when making from 25 to 27 blows per 12 hours.

As regards *accuracy*, with a suitable standard the results may be taken as fully equal to those obtained by a carefully conducted combustion process, for there are more possible sources of error in the latter, besides which, a very slight discrepancy in the weight

add 30cc. boiling water, and 12cc. sodium hydrate solution of sp. gr. 1'27; shake and make up to 60cc. for the test.

We adhere to this method, except that we add 18cc. caustic soda solution, let rest 10 minutes after shaking, and then take up to 70cc.

The chromometer itself, however, we do not use, as by its form of construction it is very liable to breakage in changing the standard; and to meet the requirements of rapid work, together with several other desiderata, I devised the form of apparatus which I now describe:—

DESCRIPTION OF APPARATUS.

The apparatus consists of the following parts (see illustration):—

Three glass tubes of equal bore throughout. The centre one is sealed at the bottom. Each of the outside ones is drawn out fine, and prolonged about three inches, passing through an indiarubber cork to within half-an-inch of the bottom of a bottle of ruby glass. On each of the tubes is loosely fitted a small cylinder, about one inch long, of glazed china clay or porcelain, or a sealed glass tube containing some heavy white powder, such as barium sulphate. Two syringes, one for each bottle, are connected therewith, either directly or with indiarubber tubing, to a small piece of glass tube, which just passes through the cork. There is also a third tube with a tap on it, which passes from the lowest point of the bottle, through the cork, and bends over for about two inches towards the back of the apparatus. Above the three comparison tubes is a mirror, which can be turned to any angle so as to enable the operator to see down them. On one side is a scale for measuring the height of the column of liquid in the tube, on the other a pointer which slides on a brass rod. A framework of mahogany for the above, the whole of which *revolves* on a circular bottom weighted with lead. The apparatus can thus be instantaneously turned round for better comparison of colour, without sacrificing its stability.

DIRECTIONS FOR USE.—Fill the centre tube up to 20 divisions with the liquid to be tested. The tubes on each side are for the standards, which may be of different depths of tint, thus enabling better comparison to be made than if only one standard is used.

To fill with standard.—Open the cock on the bent tube, stop the top of the comparison tube either with a cork or the finger, then hold a little beaker, containing the standard, so that the bent tube dips into it, and draw up the syringe, when the liquid will at once rush into the bottle.

To make the comparison.—Turn off the tap of the bent tube, remove the cork or finger from the comparison tube, and force the liquid up till the depth of tint, as shown by the mirror at the top, is equal to that of the 20 divisions of liquid being tested. Read off the height of the column on the scale, calculate, $\text{Number of divisions of standard} \times \text{percentage of standard} \div \text{number of divisions of liquid being tested} = \text{the percentage.}$

To empty out old standard.—Stop the top of the comparison tube, open the tap of the blow-out tube, and force the liquid out of the bottle by pressing down the syringe.

To clean the bottles out.—When a new standard is to be used, it is better after emptying the bottle, to suck a little of the new standard in, and force it out again. If necessary, from time to time, the bottles can be cleaned out in the same way with dilute hydrochloric acid and then water.

The ultimate selection of the form of each part has been made with reference to some special advantage, or the avoidance of some weak point.

Glass syringes have been selected as most suitable for adjusting the height of the column of liquid, as by their use it can be kept stationary at any height as long as wanted, say whilst the apparatus is revolved to compare the colour. This turning round is as necessary as the changing from side to side of the comparison tubes in the ordinary colour method, being necessitated by the light striking unequally on both tubes, thus making the depth of tint apparently vary.

I found that the standard, though not as sensitive to the action of light as in the ordinary colour method, was still somewhat subject to change in the course of the day, and as each fresh portion required 1 grm. of the standard steel, it was desirable not to have to renew it more frequently than necessary.

The bottle for holding it has, therefore, been made

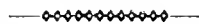
of ruby glass, and by thus excluding actinic rays, one standard may safely be used for 12 hours at least.

To avoid risk of breaking the fine part of the comparison tube in the uncorking and corking the bottle for introduction of the standard, this has been dispensed with, as owing to caustic soda getting on the cork, it was difficult to keep it tight, and in trying to screw the cork more firmly in, the fine tube almost always got broken. I have, therefore, adopted the arrangement for pumping the standard in and out, so that the cork never need be removed.

Again, when testing carbons varying from '03—'08 per cent. with a '05 standard, those with '08 showed *proportionately* too dark a tint, and required to be done with a higher standard. There are, therefore, three comparison tubes, the centre one being for the sample to be tested, and the outside ones for two standards of different percentages.

If the *same* standard be used on both tubes the apparatus will not need to be turned round, the relative position of the left hand to the centre tube being the same as that of the right-hand tube to the centre one when turned round.

We have now used this apparatus constantly for over two years, and though several thousand determinations have been made with it, we have never broken any part of it, although with the old form we were constantly breaking it just at the most inconvenient time, or finding the cork leak, through its having to be removed every time a fresh standard was inserted.



ON THE RATE AT WHICH BLEACHING POWDER LOSES ITS AVAILABLE CHLORINE.

BY JOHN PATTINSON, F.I.C., F.C.S.

IN 1874 I read a paper with the above title to the Newcastle Chemical Society. The experiments then made, which extended over about a year, were made upon samples kept in small bottles in the laboratory, and the question naturally arose: Do experiments made upon such samples indicate also if available chlorine is lost at the same rate when the bleaching powder is kept in casks of the size used in commerce? In order to ascertain this, I have made monthly tests of three casks of bleaching powder of the usual size, containing about 6 cwt. each, over a period of about twelve months, and also, for comparison, monthly tests of samples of the same kinds of bleaching powder kept in bottles holding about 4 oz each.

Two of the casks, marked A and B respectively, were filled with bleaching powder made from Irish limestone from Larne by different manufacturers. The third cask, marked C, contained bleaching powder made from "French Cliff." Twelve bottles of each kind of bleaching powder were filled at the same time and the corks sealed, and both casks and bottles were stored in a cellar. A maximum and minimum thermometer was kept near them, and a careful record of the temperature was made each working day during the year. It will be seen from Table I. (page 588), that the bleaching powder had been kept at a comparatively low and uniform temperature during the whole year, the lowest temperature noted being 38° F., and the highest 62° F.

In taking the samples from the casks, each cask was bored in a different part at the end of each month, and a sample withdrawn and tested. One of each of the bottles, marked respectively A, B, and C, was also tested each month at the same time.

Table II. shows the percentage amounts of available chlorine found in each of the various samples in each month.

TABLE I.

	Lowest.	Highest.	Average.
February	40	49	44.7
March	42	46	43.5
April	42	51	45.7
May	45	52	47.5
June	47	57	54.1
July	53	62	58.0
August	54	61	56.9
September	50	60	54.9
October	46	52	49.2
November	42	50	46.6
December	38	48	43.7

The casks and bottles were filled on the 26th and 27th of January, 1885, and the first samples were tested on the 29th January.

of calcinm. To determine chlorine existing as chlorate, a portion of the bleaching powder was boiled with a solution of sulphurous acid, to reduce both chlorates and hypochlorites to chlorides. After excess of sulphurous acid was expelled by boiling, and by the addition of a few drops of nitric acid, the solution was neutralised by carbonate of lime, and the total chlorine then ascertained by titration with standard nitrate of silver solution. The difference between the total chlorine and that existing as hypochlorite and chloride, gave the chlorine existing as chlorate. The other constituents were determined by the usual methods of analysis.

On examining the tables, it will be seen that, on the whole, there has been a gradual and regular loss of available chlorine during the eleven months over which the tests were made. The total loss of available chlorine in each sample was as follows :—

	Casks.	Bottles.
A	3.20%	2.30%
B	3.20	1.80
C	3.10	1.80

It must be remembered, however, that in the case of the casks, the loss of chlorine is reduced by this consideration : On referring to the complete analyses it will be seen that the cask samples have absorbed

TABLE II.

DATE WHEN SAMPLE WAS TESTED.	CASKS.			BOTTLES.		
	A.	B.	C.	A.	B.	C.
1885.						
January 29	37.00	38.30	36.00	37.20	38.00	36.10
February 27	36.90	38.10	35.90	36.90	37.80	35.90
March 30	36.70	38.00	35.60	36.90	37.40	35.60
April 28	36.90	37.80	35.50	36.80	37.60	35.60
May 28	36.30	37.40	35.20	36.60	37.10	35.60
June 25	36.10	37.00	33.90	36.20	36.90	35.20
July 28	35.30	36.70	33.90	35.80	36.60	34.60
August 28	35.20	36.20	33.90	35.70	36.20	34.70
September 29	34.60	36.00	33.70	35.50	36.20	34.80
October 29	34.80	35.80	33.50	35.70	36.00	34.60
November 30	34.50	35.40	32.80	35.10	36.00	33.80
1886.						
January 5	33.80	35.10	32.90	34.90	36.20	34.30

A complete analysis of each of the cask samples was made at the beginning and also at the end of the experiments. These analyses are given in Table III. (page 589).

The bottle samples were also examined at the beginning and end of the period for chlorine existing as available chlorine (hypochlorite), chlorate and chloride, with the results given in Table IV. (page 589).

The methods of analysis employed were the following :—The available chlorine was determined by Penot's method—that is, with a standard solution of arsenious acid. To determine the chlorine existing as chloride, the portion in which available chlorine had been determined was acidulated with nitric acid, the excess neutralised with carbonate of lime, and then titrated with standard solution of nitrate of silver. The difference between the amount of chlorine thus indicated and the amount indicated by Penot's test, gives the chlorine existing as chloride

carbonic acid and water from the atmosphere during the year, and thereby increased in weight. The amount of this absorption is no doubt greater in these experimental casks than it would be in casks under ordinary circumstances, for the gradually-increasing number of holes bored in these casks and into the middle of the bleaching powder necessarily allowed greater access of air to the bleaching powder than would be the case with casks that are not so treated. The additional amounts of carbonic acid and water absorbed by the cask samples were as follows :—

A cask	2.32%
B "	2.05
C "	2.95

On making allowance for this increase in weight, the amount of loss of available chlorine in the cask samples is reduced to the following percentages :—

A cask	2.40%
B "	2.46
C "	2.10

Thus showing that the loss of available chlorine in the cask samples does not differ much from the loss in the bottle samples—the average loss in the cask samples being 2·32 per cent., and in the bottle samples 1·97 per cent., or a difference of 0·35 per cent.

And so with regard to the total chlorine; the loss of total chlorine in the casks and bottles, as sampled, was as follows:—

	Casks.	Bottles.
A	1·36	0·86
B	1·45	0·43
C	1·71	0·63

When, however, the same correction as above is made for gain of weight in carbonic acid and water in the cask samples, the loss of total chlorine in these is as follows:—

A cask	0·50
B "	0·67
C "	0·65

Or just about the same amount of loss as in the bottle samples, the average loss of the cask samples being 0·61 per cent., whilst the average loss of the bottle samples is 0·66 per cent.

increased by the following percentage amounts during the year:—

	Casks.	Bottles.
A	2·69	1·62
B	1·83	1·54
C	1·65	1·38

From a consideration of the above results, it will be seen that when bleaching powder is kept either in casks or in bottles for about twelve months under the conditions above specified—that is, at a temperature not exceeding about 60° F., it loses not more than from two to three per cent. of its available chlorine, and under one per cent. of its total chlorine.

It is not often, however, that bleaching powder can be stored in places where so low a temperature as 60° F. can be maintained for any length of time, at any rate, in the summer months, and in many cases it will be stored in places where a temperature of 70°, or even 80° F. will prevail. It seems desirable, therefore, to determine at what rate available chlorine is lost at these higher temperatures, more especially as my experiments made in 1874 indicated that a much greater loss of available chlorine took place

TABLE III.

	JANUARY 29, 1885.			JANUARY 5, 1885.		
	A.	B.	C.	A.	B.	C.
Available chlorine	37·00	38·30	36·00	33·80	35·10	32·90
Chlorine as chloride	0·35	0·59	0·32	2·44	2·42	1·97
Chlorine as chlorate	0·25	0·08	0·26	none	none	none
Lime	44·49	43·34	41·66	43·57	42·61	43·65
Magnesia	0·40	0·31	0·43	0·31	0·36	0·38
Peroxide of iron	0·05	0·04	0·02	0·05	0·04	0·02
Alumina	0·13	0·41	0·33	0·35	0·36	0·35
Oxide of manganese	trace	trace	trace	trace	trace	trace
Carbonic acid	0·18	0·30	0·48	0·80	1·18	1·31
Siliceous matter	0·10	0·39	0·50	0·50	0·40	0·50
Water and loss	16·15	16·33	17·00	18·15	17·00	18·89
	100·00	100·00	100·00	100·00	100·00	100·00
Total chlorine	37·60	38·97	36·58	36·24	37·52	34·87

TABLE IV.

	JANUARY 29, 1885.			JANUARY 5, 1885.		
	A.	B.	C.	A.	B.	C.
Chlorine as Hypochlorite	37·20	38·00	36·40	34·90	36·20	34·30
„ Chlorate	0·18	0·17	0·26	none.	none.	none.
„ Chloride	0·40	0·72	0·39	2·02	2·26	1·77
Total Chlorine	37·78	38·89	36·75	36·92	38·46	36·07

The small quantity of chlorine found as chlorate in each sample at the beginning of the experiments, ceased to exist in this combination at the end, and from tests made it was found that all chlorate had disappeared in May, or about four months after the casks and bottles were filled.

The amounts of chlorine existing as chloride had

during the summer months than during the colder winter months. It is my intention to keep samples of bleaching powder at fixed higher temperatures for a lengthened period, and to note the changes which take place from time to time. The results obtained will be laid before the members of this Society at a future time.

Glasgow and Scottish Section.

Chairman: J. Neilson Cuthbertson.

Vice-chairman: Prof. Mills.

Hon. Vice-chairman: E. C. C. Stanford.

Committee:

J. B. Adam,
J. Addie,
Prof. Crum-Brown,
J. Y. Buchanan,
J. Christie,
W. J. Chrystal,
W. S. Curphey,
Prof. Ferguson.

J. Fyfe,
R. Irvine,
T. P. Miller,
J. M. Milne,
J. Pattison,
R. Pullar,
R. R. Tatlock,
A. Whitelaw.

Hon. Treasurer:

J. J. Coleman, Ardarroch, Bearsden, near Glasgow.

Local Secretary:

G. G. Henderson, Chemical Laboratory,
University of Glasgow.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

The First Meeting of the Session was held in the Rooms, 207, Bath Street, Glasgow, on Tuesday, November 2, 1886.

MR. J. NEILSON CUTHBERTSON IN THE CHAIR.

CHAIRMAN'S ADDRESS.

THE CHAIRMAN, in his introductory address, gave a brief account of the proceedings of the parent society during the past year. The roll of membership, he mentioned, stood now at 2271, of whom 251 belonged to the Glasgow Section, only two of the sections being larger, London and Manchester, with 442 and 312 members respectively. During the past session 82 original papers were read, of which 17 were contributed by their own Section. One important matter in which the Section took part was that in promoting the success of the Edinburgh Exhibition. A small sub-committee was appointed and drew up a circular, which was sent to the chemical manufacturers of Scotland. The committee also attended the meetings of the local executive, and the result was that there was at Edinburgh a very respectable, if not complete, exhibition of the chemicals manufactured in Scotland. It had been announced that Exhibitions were to be held in Manchester and Newcastle next year, and the citizens of Glasgow had agreed that there should be one here in 1888. He thought the Section would form a very good organisation for interesting the chemical manufacturers of Scotland in securing a good chemical collection for the Glasgow Exhibition. He was old enough to remember a small chemical exhibition got up in Glasgow many years ago, and he believed the proceeds of that exhibition, small as it was, formed the nucleus of the Philosophical Societies' fund that had been invested in the building in which they were now met. He hoped that there would be a surplus as the result of the forthcoming great Exhibition, and that it might be devoted to some great local undertaking or institution. It would be observed from the programme that the title of the Section had been changed, and that it was now called the Glasgow and Scottish Section. The object of this was to provide for occasional meetings in Edinburgh, and probably in Dundee. The meeting in February was to be held in Edinburgh, and he looked forward to its being eminently successful. He saw no reason why they should not spread their wings all over Scotland, and excite much larger interest than they had yet attempted. Another most important matter was that they had invited the parent society to hold its annual meeting in Glasgow in July next,

and that the invitation had been accepted. That the sixth meeting of the Society should be held in Scotland was only due to the importance and extent of the chemical industries and manufactures of this neighbourhood. Before the Exhibition of 1888 was opened he hoped we should have a revival of trade. He was sure the members of the Society must be wearying for the return of prosperity. He believed he was correct in saying that the chemical industries, as well as others, had for a long time been labouring under a state of dulness and absence of remuneration which was not formerly experienced. In looking over a price list that morning, he found that all chemical articles were lower in price, or not higher, than they were a year ago, with one exception—namely, bleaching powder—and he did not know that they could attribute that to a revival of trade. He had no doubt that the depression which we had been experiencing for some time past would have good effects. It would lower costs all round, and be the means of enabling them to compete with other countries, and lead to what always helped in that and all other industries, the survival of the fittest.

A METHOD OF USING ANTIMONIOUS CHLORIDE FOR FIXING COAL-TAR COLOURS ON COTTON FIBRES.

BY GEORGE WATSON, F.C.S.

IN dyeing and calico printing processes, the only use made of compounds of the metal antimony is as an auxiliary in the fixation of coal-tar colours on cotton. Their application for this purpose depends upon the fact, that on mixing their aqueous solutions with aqueous decoctions of certain tannin substances, precipitates are produced capable of being dyed with various coal-tar colours, thus forming lakes. In practice it is usual to produce these lakes directly on the fibre by a proper combination of the three operations of tanning, antimoniating, and dyeing.

For various reasons, tartar-emetic was the salt of antimony adopted when this method of fixing was introduced, and, technically speaking, it served the purpose admirably. One drawback, however, it possessed—viz., its comparatively high price, due to the large percentage of potassium tartrate contained in it, and all the preparations proposed as substitutes are merely intended to give a salt as suitable, at a less cost.

Now, antimonious chloride is a salt possessing the necessary qualification of cheapness, being the least expensive salt producible, but unfortunately it, like most other antimony salts, is basified by water, and is thus rendered useless for the purpose of the dyer. It is the object of the method which I am going to describe, to show how this basification by water may be cheaply and efficiently prevented, thus enabling baths of any desired strength to be prepared.

It is known that antimonious chloride is capable of forming double salts with certain other metallic chlorides, such as the alkaline chlorides, and as it is obviously necessary for the production of these compounds that both salts should be simultaneously co-existent in solution, I concluded that antimonious chloride ought to be miscible in any degree with strong or saturated aqueous solutions of these chlorides. On making preliminary experiments, I found that to appearance, perfect miscibility was produced on admixture with saturated solutions of sodium, ammonium, magnesium and calcium chlorides; while potassium and barium chlorides yielded liquids more or less turbid. I thought it would therefore be

of interest, and possibly of value, to examine, under similar experimental conditions, the effect of varied quantities of the three first-named chlorides in preventing the decomposition of antimonious chloride by water. To these I have added potassium chloride for the sake of comparison.

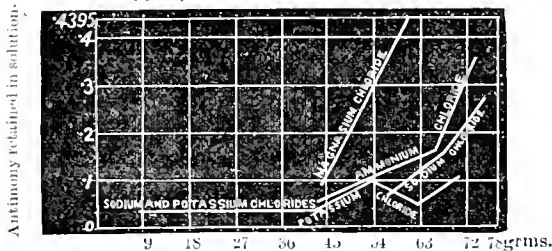
For this purpose, I have carried out a number of experiments, the description of one of which will suffice to show the method of procedure of the whole.

Into a glass beaker of 300cc. capacity, 210cc. of water were placed. A definite weight of the metallic chloride under examination was then added and stirred till dissolved. The whole was next allowed to stand several hours, generally over-night, in order that the cooling effect due to solution might become dissipated. The temperature was then noted to make sure that each experiment was approximately similar in this condition. Exactly 1grm. of aqueous solution of antimonious chloride (of a known percentage of antimony), weighed in a watch-glass, was then added and well mixed by stirring. The whole was next allowed to stand eighteen hours. The treatment at the end of this time varied. In some experiments the watch-glass was withdrawn, freed from adherent precipitate by friction with a glass rod, tipped with indiarubber, the precipitate separated by filtration, washed with 210cc. of water, containing in solution an amount of metallic chloride identical with that used in the experiment, and the antimony in the precipitate determined by titration with standard solution of potassium permanganate. In other experiments, the antimony remaining in solution was estimated by titration of an aliquot portion of the clear supernatant liquid. The results of these experiments are embodied in the annexed table and diagram.

On examining these figures, several remarkable

case of sodium and ammonium, appears to be manifested in a regular manner, until saturation is nearly reached, when a great increase in efficiency takes place. The action of magnesium chloride occurs in a more uniform manner throughout, while potassium chloride exhibits a remarkable increase in effect at 53grms., decreasing again on further additions of the salt, and finally increasing on the saturation point being reached.

Diagram illustrating the effects of Sodium, Potassium, Ammonium, and Magnesium Chlorides.



Represented graphically, the action of sodium and ammonium chlorides consists each of three straight lines, forming different angles with the abscissa, while that of magnesium chloride consists of one straight line only. Representing by E the chemical effect or antimony retained in solution, and by y a weight of sodium chloride, the equation for the first part of the action may be put in the form $E = my + c$, m being the tangent of an infinitely large angle, is equal to 0. Hence $E = c$ for all values of y . From the point represented by 49.966grms. the effect is proportional to the sodium chloride, and may be expressed by the equation $E = (y - d)b$, where d and b are constants. The values of d and b , calculated from the experiments with an asterisk, are 49.784 and

TABLE SHOWING THE EFFECTS OF SODIUM, POTASSIUM, AMMONIUM AND MAGNESIUM CHLORIDES.
Temperature 12° to 15° C. Antimony in 1grm. Solution of Antimonious Chloride = 0.4395grm.

Sodium Chloride.	Antimony in ppt.	Calc.	Potassium Chloride.	Antimony in ppt.	Calc.	Ammonium Chloride.	Antimony in ppt.	Calc.	Magnesium Chloride.	Antimony in ppt.	Calc.
none	0.4395	—	—	—	—	—	—	—	—	—	—
8.155	0.3953	—	6.967	0.4277	—	—	—	—	—	—	—
15.884	0.4026	—	12.776	0.4248	—	—	—	—	—	—	—
23.804	0.4130	—	19.818	0.4189	—	—	—	—	—	—	—
32.771	0.4041	—	25.871	0.4130	—	—	—	—	—	—	—
36.417	0.4113	—	32.732	0.4160	—	—	—	—	—	—	—
43.939	0.4014	—	39.636	0.4174	—	*43.939	0.3774	0.3774	43.939	0.3151	0.3125
49.966	0.3896	—	46.076	0.3864	—	46.070	0.3203	0.3665	45.672	0.2243	—
53.003	0.3856	0.4115	53.013	0.3377	—	49.966	0.3130	0.3167	47.955	0.2728	0.2673
55.967	0.3691	0.3849	55.969	0.3510	—	53.013	0.3121	0.3311	49.966	0.2480	0.2281
*59.149	0.3544	0.3542	59.459	0.3716	—	55.967	0.3253	0.3160	52.142	0.2057	0.1863
61.966	0.3223	0.3320	61.966	0.3790	—	59.450	0.3022	0.2982	54.045	0.1221	0.1194
63.503	0.3163	0.3181	—	—	—	61.966	0.2996	0.2854	*55.967	0.1122	0.1123
*64.930	0.3057	0.3054	—	—	—	*63.784	0.2761	0.2762	58.993	none	none
66.489	0.2961	0.2921	—	—	—	67.000	0.2511	0.2597	61.966	„	„
68.039	0.2740	0.2785	—	—	—	69.050	0.2251	0.2490	—	—	—
Saturated	0.1758	—	Saturated	0.3289	—	Saturated	0.0833	—	Saturated	none	none

facts are revealed. For instance, in the case of sodium, potassium, and probably of ammonium chlorides, the effect of the metallic chloride, although appreciable, is constant until about 40grms. have been added. From about this point the effect, in the

case of sodium and ammonium, appears to be manifested in a regular manner, until saturation is nearly reached, when a great increase in efficiency takes place. The action of magnesium chloride occurs in a more uniform manner throughout, while potassium chloride exhibits a remarkable increase in effect at 53grms., decreasing again on further additions of the salt, and finally increasing on the saturation point being reached.

then $E = b$. Hence b is the effect produced by 1 grm. of sodium chloride.

The equations for ammonium chloride (for the analogous part of the effect) and magnesium chloride are of the same form; the values of the constants d and b being 31.774 and 0.00511 for ammonium, and 39.063 and 0.0194 for magnesium. The calculated results are given in the table.

If γ and γ_1 represent equal weights of sodium and ammonium chlorides respectively, then the quotient of the expression—

$$\frac{(\gamma_1 - d_1)b_1}{(\gamma - d)b}$$

is the efficiency of ammonium chloride when that of sodium chloride is unity. On calculating this for different but equal values of γ and γ_1 , it is found that the efficiency of ammonium chloride as compared with that of sodic chloride is variable, and decreases as the values of γ and γ_1 augment. Under-noted are the ratios for certain values of γ :—

$\gamma = \gamma_1$	$\frac{E_1}{E}$
= 33.003	2.1781
" = 35.967	1.7526
" = 40.000	1.6035
" = 42.000	1.4360
" = 44.000	1.3136
" = 46.000	1.2250
" = 48.000	1.1511

For an equal weight, then ammonium chloride is twice as efficient as sodium chloride at the point 33.003 grms., and decreases gradually until at the point 68 grms. it is only about equally so. Making

$$\frac{E_1}{E} = 1,$$

then the corresponding values of γ and γ_1 are the mutual equivalents of the two chlorides. These are inversely proportional to their efficiencies, so that if the equivalent of sodium chloride is unity, that of ammonium chloride will be the reciprocal of its efficiency.

Calculating in the same way the efficiency of magnesium chloride as compared with ammonium chloride, I find that the ratio increases as the amounts of chloride augment. At the point, 50 grms., it is twice as efficient, at 54 grms. $2\frac{1}{2}$ times, and at 58 grms. $2\frac{3}{4}$ times. With saturated solutions of the three alkaline chlorides, taking potassium chloride as unity, the efficiencies of sodium and ammonium are 2 and 3 respectively.

In adapting these results to practice, potassium chloride, from its low efficiency, and ammonium chloride from its high price, will not be available. We are therefore reduced to the use of sodium or magnesium chlorides, or a mixture of both. As sodium chloride, even in saturated solutions, does not retain all the antimony in solution, means had to be devised to overcome this objection.

When a large proportion of water is added to antimonious chloride, the precipitate formed is said to have a composition represented by the formula $Sb_4O_3Cl_2$. Assuming that the antimony precipitated has carried down chlorine according to this expression, then the ratio of the antimony to chlorine remaining in solution is found on calculation to agree with the expression $Sb : 4\frac{1}{2}Cl$. Hence if this ratio exist before adding the antimony to solution, no precipitation should occur. This is verified on trial. In order to prepare a bath, then, we simply take a cold saturated solution of sodium chloride and add the antimonious chloride previously acidified in the above proportion.

By a suitable admixture of magnesium chloride with the sodium chloride, the amount of free hydro-

chloric acid present may be greatly reduced, or indeed dispensed with altogether. In manufacturing antimonious chloride on the large scale, a small proportion of free hydric chloride is always necessarily present, as it is impossible to fully saturate hydrochloric acid of 1.160 sp. gr. with antimonious oxide by boiling. The resulting liquor contains about 23 per cent. of antimony calculated as metal, the ratio of antimony to chlorine being about $4Sb : 15Cl$. Using the antimonious chloride in this condition, perfect solution is obtained on adding to a bath prepared according to the following formula :—

10 gallons water.
30lb. sodium chloride.
20lb. magnesium—in crystals.

If it is desired to use magnesium chloride alone, then we simply take a solution of this salt of a strength in accordance with the experimental results—viz., about 60 grms. of the anhydrous salt in 210 grms. of water. By taking the antimonious chloride in the condition above described, however, this proportion of magnesium chloride may be greatly diminished, the following being the formula for the preparation of a bath :—

10 gallons water.
62lb. magnesium chloride in crystals.

The method of applying the trichloride consists then simply in this, that a bath is prepared according to one of the formulae given, and to it is added the antimonious chloride. I now proceed to consider the advantages offered by this salt used in this way over tartar emetic and the double oxalate with potassium. These may be divided into two groups, those of a financial and those of a technical or chemical value.

Tartar emetic of ordinary quality costs about 1s. 1d. per lb., and contains 35 per cent. of antimony calculated as metal. Antimony potassium oxalate contains 22 per cent. of antimony as metal, and costs 8½d. per lb., while the chloride solution contains, as already mentioned, 23 to 24 per cent. of antimony, and is sold at 7d. per lb. Calculating these to the basis of tartar emetic, the following relative costs are obtained :—

Tartar emetic (35 per cent. antimony)	13d. per lb.
Oxalate	13½d. "
Chloride	10½d. "

So that regarding only the contents of antimony, the double oxalate is not any cheaper than tartar emetic, while the chloride is only 4.5ths of the cost of either. To the price of the latter, however, must be added that of the sodium or other chloride used in conjunction. Supposing sodium chloride alone to be used (and this salt, from its low price, will probably be mostly used in practice), the addition to the cost will be very small, and should not exceed one penny per lb. If a mixed solution of sodium and magnesium chlorides be used, the cost will of course be more, but will in any case be dependent on the amount of antimony (per gallon of the bath) consumed before the bath is discarded.

Considered technically, it is also probable that the chloride will possess certain advantages over tartar emetic.

One might conjecture, from the facility with which antimonious chloride is basified by water, that its solution in conjunction with any of the before-named chlorides would be in a state of very unstable equilibrium, ready to deposit its antimony on the least inducement. That this is so, a very simple experiment shows. If the sides of a glass vessel, containing some antimonious chloride dissolved in saturated solution of sodium chloride, be scratched with a glass rod, the fine lines thus formed become traced out, in

a short time, by the deposition of basic antimonious chloride. Now, when an abrasion is produced on any surface, a certain amount of energy is expended in overcoming the cohesion of the material composing the surface. This energy assumes the potential state, and resides in the path of the abrasion. When, therefore, such abrasions are placed in suitable conditions, their potential transforms itself—that is, does work which, in the experiment described, consists of the separation of a small quantity of antimonious oxide from its combination with chlorine. A similar solution of tartar emetic in water treated in the same way does not give any deposit. In this case the potential of abrasion is not powerful enough to overcome the mutual attraction of antimony and tartaric acid. The double oxalate behaves similarly to the chloride.

Now cotton fibres exert an attraction for reagents, by virtue of which they decompose weak solutions of certain metallic salts in such a way that the metallic oxide becomes fixed in the pores of the fibre. If we have to choose, then, between two salts of a given metal, we select that which gives least work for the fibre to do, as this means economy in time and possibly in material. Proceeding on this basis, antimonious chloride would be a better salt to use than tartar emetic. This conclusion, in the case of the double oxalate, is said to be verified by practical experience on the large scale, and indeed constitutes its sole advantage over tartar emetic.

In order to test this deduction in the case of the chloride, I have performed several dyeing experiments with the two salts used under like conditions.

Similarly tanned hanks of bleached cotton yarn, of equal size, were immersed for 30 seconds in solutions of tartar emetic and of the chloride respectively. The strengths of the solutions were 0.5, 1 and 1.5 grms. in 200cc. of water and mixed solution of sodium and magnesium chlorides, the temperature during the immersion being 15° C. The percentage of antimony in the tartar emetic was 38.0, and in the chloride 24. The hanks were then dyed up with Victoria green and safranin. From these it is seen that in each case the chloride, although only two-thirds of the strength of the tartar emetic, has given quite as full a colour as the latter, showing that equal amounts of antimonious oxide have been absorbed in each case.

Minor advantages which suggest themselves are contained in the fact that the tannate of antimony is more insoluble in solution of sodium chloride than in water, and will be more completely fixed, in consequence of which the bath will not be so quickly fouled. It is also evident that as the stability of the bath increases during absorption of its antimony, and consequent liberation of acid, by the simple addition of water in regulated quantities, the influence of the acid may be eliminated, and any desired degree of instability again produced. In this way it may be possible to absorb all the antimony from a bath, the acid may then be neutralised by the addition of alkali, and the bath will again be ready for a new addition of antimonious chloride.

I shall now exhibit some samples of cotton yarn, dyed by myself, by means of the process, also for comparison some similar hanks fixed with tartar emetic. All these hanks were tanned in the same way, one half of them being fixed in a solution of tartar emetic, containing 1 grm. in 200cc. of water, the remaining half being fixed in a solution of 1 grm. of the chloride in 200cc. of mixed solution of sodium and magnesium chlorides. They were then all dyed up in the same way. I have also here some strips of calico fixed with the chloride, and kindly prepared for me by the Fereneze Printing Co., Barrhead. These will serve to

give at least an idea of the results obtainable by the process.

It may be of interest to say here a few words regarding the action of hydrochloric acid solution on antimonious sulphide. This reaction, as well as all others in which solids are concerned, is largely influenced by a factor to which not much thought has been given—viz., cohesion. It is obvious that the finer grained the antimonious sulphide is, the shorter will be the time required to convert it into chloride. The production of a state of comminution is accompanied by the transformation of some of the force of cohesion into some other form of energy. This can only be the storage of its equivalent of potential in the solid substance so divided. Hence, when such a divided solid is undergoing chemical change, its potential of comminution reappears in the form of heat, and accelerates the reaction. The element of time—an important factor in all changes—is shortened. The reaction of hydrochloric acid solution and antimonious sulphide, which is usually expressed by the so-called equation $\text{Sb}_2\text{S}_3 + 6\text{HCl} = 2\text{SbCl}_3 + 3\text{H}_2\text{S}$, could only possibly occur if the time allowed were enormous; that is, if the antimony sulphide be in compact masses. If it were possible to reduce a solid to a state of infinite tenuity—that is to say, to a state in which, although possessing many of the properties of a solid, cohesion is non-existent—all reactions, in which it then took part, would at once proceed to a termination, expressible by the usual chemical symbols, using as coefficients the smallest possible integers. This is a condition impossible to realise, and, therefore, all such reactions must stop as soon as the forces concerned are equilibrated.

In manufacturing operations in which antimonious sulphide in a state of moderate fineness, such as is produced by grinding in a pan mill, is heated with hydric chloride solution of sp. gr. 1.160, the point of equilibrium is reached when about one-half of the antimony, indicated in the above expression, has been dissolved. Bearing in mind the alleged existence of an acid chloride having the formula $\text{SbCl}_3 \cdot 3\text{HCl}$, this fact may be possessed of some importance.

In conclusion, it gives me much pleasure to record my indebtedness to the Fereneze Printing Co., Barrhead, for their kindness in preparing the pieces of calico exhibited. I may also be allowed to state that this process, in all its modifications, has been patented.

DISCUSSION.

Prof. MILLS considered the paper as a model of scientific as well as technical investigation. There was plenty of room for a new and cheaper antimony mordant; and Mr. Watson's had obvious advantages over those in common use. He considered the precipitation of oxychloride in a rough glass surface to be probably due to the same cause as the mordanting of cotton goods, and suggested trying the experiment in a beaker wholly roughened inside.

Mr. PATTISON asked how much tannic acid was used with the dyed samples? Because, if tannic acid was present in large quantity, being itself a mordant for aniline colours, the dyed samples would look equally well, independent of the antimony salts, and the relative merits of tartar emetic and antimony chloride would not be so well brought out.

Mr. WATSON, in reply, said he intended to try the experiment as suggested by Professor Mills, later on. Replying to Mr. Pattison, he stated that the amount of sumac used was 8 grms. to 50 grms. cotton yarn. The sumac was boiled with water, and the solution filtered off from the residue. The yarn was treated with filtrates in the usual way.

Nottingham Section.

Chairman : Prof. Clowes.
Vice-Chairman : Lewis T. Wright.
Treasurer : J. B. Coleman.
Committee :

L. Archbutt.	W. Jennings.
W. A. Curry.	T. W. Lovibond.
H. Doidge.	H. J. Staples.
R. Fitzlugh.	E. B. Truman.
E. Francis.	R. L. Whiteley.
Claude Hollins.	

Hon. Local Secretary :

J. R. Ashwell, Midland Lodge, Bentinck Road,
Nottingham.

Dec. 13.—Lewis T. Wright, C.E., "On Liquid Fuel, with special reference to Tar Burning."

Notices of papers and communications for the meetings to be sent to the Local Secretary.

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Improvements in the Manufacture of Cement, and in Machinery or Apparatus in connection therewith. R. Stone, London. Eng. Pat. 10,934, Sept. 15, 1885. 8d.

THE improvements specified consist of (1) an improved wash-mill, wherein the chalk or lime and river mud are broken up and incorporated by agitator arms provided with toothed harrows attached thereto by chains, ropes, or rods; (2) a blending-mill, consisting of an upright cylindrical vessel, provided with an agitating shaft fitted with arms; (3) improved forms of crushing-rods, the peripheries of which are serrated and fit into each other.

—C. C. H.

Improvements in Furnaces for Distilling and Refining Mineral Oils. A. Morton and J. Fyfe. Eng. Pat. 13,096, Oct. 30, 1885. 8d.

THIS is an application of the principle of the Siemens regenerative furnace to the furnaces of oil-stills, etc. In addition to the ordinary flue leading to the chimney, other flues and passages are so arranged, by dampers or valves, that any proportion of heated air after passing through the hotter furnaces may be transferred or conducted to the colder furnaces, thus economising fuel and consuming smoke. Drawings are given.—W. L. C.

Improvements in Machinery or Apparatus for Separating Dust from Air. H. H. Lake. From the Knickerbocker Company, Michigan. Eng. Pat. 9423, July 20, 1886. 8d.

THE inventor claims to clear air from dust or small particles with which it may be laden in mills and factories, by leading it with a rotary motion into a vessel of special shape whereby the dust is deposited on the inner walls of such vessel, and the air escapes in a pure state. The proposed vessel is made in shape a plain inverted cone, the apex at the lower end being provided with a small opening. The broad upper end of the cone is closed, excepting a large central opening from which depends a short open cylinder reaching some distance down into the interior. The dust-laden air arrives at the periphery at the upper part of the cone in a tangential direction, and entering at considerable speed is forced to rotate in

close proximity to the sides of the cone, on which the dust and small particles are deposited. These slowly find their way to the discharge opening below, whilst the purified air, after losing its rotary motion, escapes under the edge of the depending central cylinder. In practice, the inventor finds that the fine dust follows the tapering sides of the cone towards the apex, whilst the larger and heavier particles move towards the large end, which peculiarity may be taken advantage of for separating the materials according to size. Scrapers may be fitted inside the cone to facilitate the movement of the dust.

—B.

Improvements in Apparatus for obtaining Fresh Water from Salt Water, and for Working, in connection with Motive Power, Heating and Cooking Apparatus on Board Ship. J. Weir. Eng. Pat. 9567, July 24, 1886. 6d.

ALTHOUGH not strictly within the limits of subjects for this Journal, the idea underlying this invention may be considered worth noting for possible application in chemical operations. It relates to improvements on a previous patent No. 11,865 of 1884, by the same patentee, in which he proposes the use of very high-pressure steam for heating and evaporating the water in a separate vessel with the view to the production of fresh steam at lower pressure and for independent application. The invention is intended to be applied primarily to modern steamships where steam at very high pressure is used for driving the main engines, whilst steam of lower pressure is required for the auxiliary engines, for the fresh water and cooking apparatus and for other purposes. In such cases the inventor simply proposes the use of what amounts to a secondary boiler, which, instead of being heated by fire in the ordinary way, is traversed by tubes through which the high-pressure steam circulates, transmitting heat to and raising steam from the water by which they are surrounded.—B.

II.—FUEL, GAS, AND LIGHT.

On Combustion, with Special Reference to Practical Requirements. F. Siemens. Iron and Steel Institute, Oct. 1886.

IN order to ensure perfect combustion: (1.) The gases must be supplied in the exact chemical proportion in which they are required for this purpose; an argument in favour of using gaseous fuel, which admits of perfect control over combustible as well as supporter of combustion. (2.) The gases must be brought together in such a manner that the different molecules which have to enter into combination may readily do so. This end may be attained by mixing the gases before combustion as in a Bunsen's burner, but this is only applicable where small surfaces are to be heated by direct contact with flame (a method highly destructive to the material heated),* large flames of high radiative power being more economical for most purposes. In reverberatory or boiler furnaces fired with solid fuel, no difficulty is experienced in obeying this rule, and the heating will be satisfactory in proportion as the coal used evolves gases yielding a flame of higher radiating power. In regenerative gas furnaces, however, the mixture involves a greater difficulty; if it be too intimate, a short hot flame of low radiative value is produced, whereas if the gases do not properly combine, perfect combustion cannot take place. The usual method of introducing the gases into the regenerative furnace, with the ports for the heavier air placed above those for the lighter producer-gas is satisfactory unless the specific gravities of the two gases approach by reason of the regenerators being applied to the heating of the air alone, a system attended therefore by great disadvantages. (3.) Everything must be avoided which interferes with the motion of the gases while combustion is proceeding. The reason previously assigned† for this interference of solid bodies, which prevent the free development of the flame, must now be supplemented by

* F. Siemens : Jour. Soc. Chem. Ind., 1885, 139.

† Vide Siemens, *loc. cit.*

* Any of these specifications may be obtained by post, by remitting the cost price, plus postage, to Mr. H. Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8s.....	4d.
Above 8s., and not exceeding 15s. 6d....	1d.
" 15s. 6d., ..	2s. 4d.
" 2s. 4d., ..	2s. 4d.

considerations connected with the dissociation of gases at high temperatures,* as fully explained by the author in a recent lecture at the Royal Institution. Heated surfaces favour the dissociation of gases coming into contact with them; thus the earlier experimenters in this subject who passed the gases through heated tubes filled with roughly broken porous particles, have given too low a temperature for the dissociation limit of each gas examined. When the path of the gases is unobstructed, dissociation commences only at a much higher temperature, and the flame becomes shorter and more brilliant with each rise of temperature, instead of increasing in length, as the older theory of alternate combustions and dissociations would involve: this point may be proved by a study of the regenerative gas burner, where the flame, long at first, becomes, as the regenerators are heated, shorter and whiter, the passage of the gases during combustion being entirely free throughout. Thus, to obtain the maximum value from a fuel, the full radiative action of an unobstructed flame should be first secured, and then the residual heat in the products of combustion should be utilised by contact as thoroughly as possible.—W. G. M.

Improvements in Bunsen and other Atmospheric Gas Burners. T. Fletcher, Warrington. Eng. Pat. 13,433, August 4, 1886. 8d.

A GAUZE CAP with turned-down edges is fitted to the inside of the Bunsen burner. To prevent the cap entering further than is required, there is formed within the burner a shoulder or annular recess, against or within which the turned-down edge may rest.—A. R. D.

Improvements in Regenerative Gas Lamps. T. A. Green and C. M. Walker, London. Eng. Pat. 13,330, August 5, 1886. 8d.

JUST above the flame is situated a "generator" of spheroidal shape communicating with the atmosphere by lateral radial tubes, and opening underneath into another vessel which envelops both burner and generator. In the lower part of this enveloping vessel is placed a reflector of suitable material. Air enters the generator by the radial tubes, and being thus heated passes downwards to the burner. The products of combustion pass upwards on the outside of the generator between the radial tubes, and away by the chimney with which the enveloping vessel is surmounted.—A. R. D.

Improvements in the Manufacture of Compound Fuel. J. G. Penn, Cardiff. Eng. Pat. 13,990, August 16, 1886. 6d.

THE patentee mixes paraffin pitch with small coal and compresses the mixture into blocks. The paraffin pitch is the residue obtained in the distillation of rock oil, crude petroleum, or other such-like material. Fuel so made may be enriched for gas-making or other purposes by the addition of an illuminating oil. The proportions used vary, of course, with the kind of coal; but, generally, they are 7 to 10 per cent. of paraffin pitch, 4 to 8 of oil, and 82 to 89 per cent. of coal. This fuel is inodorous and smokeless, neither does it fall to pieces when stirred upon the bars.—A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Occurrence of Acridine. J. Walter. J. Prakt. Chem. 1886, 34, 134.

THE author has isolated acridine from the last portions of the distillate obtained by subjecting crude diphenylamine to distillation. The production of this base is attributed to the synthetical formation of acridine from

orthotolylphenylamine, discovered by Graebe (this Journal, 1884, 474). The purest aniline of commerce contains minute quantities of toluidines, which, during the process of preparing diphenylamine, are resolved into ditolylamines and phenyl-tolylamines, and of which orthophenyltolylamine yields acridine by the elimination of two atoms of hydrogen.—D. B.

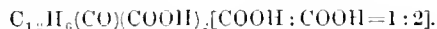
Occurrence of Cymene and an Aromatic Hydrocarbon C_9H_{12} in Rosin Spirit. W. Kelbe. Ber. 19, 1969—1970.

IN isolating metaisocymene from rosin spirit by means of the sparingly-soluble barium alpha-meta-isocymenesulphonate, the mother-liquor deposits on standing a crystalline compound from which, after several recrystallisations, barium paracymenesulphonate, $(C_{10}H_{12}SO_3)_2Ba + 2H_2O$, was obtained. The sulphonamide crystallises in large lustrous scales melting at 115.5°. As Jacobsen found the melting-point of paracymenesulphonamide to be 111—112° (Ber. 11, 2049), the author prepared this compound from paracymene and obtained a substance melting at 115.5°. He is therefore of opinion that both sulphonamides are identical, and claims to have established the existence of paracymene in rosin spirit.

On sulphonating the portion of the aromatic hydrocarbons of rosin spirit boiling under 160°, a barium salt was obtained having the composition, $(C_{10}H_{11}SO_3)_2Ba + H_2O$. The sulphonamide crystallises from water in small scales melting at 130°. Owing to the want of material the investigation of this hydrocarbon could not be pursued.—D. B.

On Pyrene. E. Bamberger and M. Philip. Ber. 19, 1995—1999.

IN a previous communication (this Journal, 1886, 449) it was shown that pyrenic acid, $C_{15}H_8O_3$, obtained by the oxidation of pyrene or pyrenequinone with chromic acid mixture, is a dibasic acid the carboxyl groups of which are attached to two carbon atoms directly united to one another, whilst the fifth oxygen atom belongs to the carbonyl group, hence the authors ascribed to pyrenic acid the constitution—



It is now shown that pyrenic acid possesses the character of a ketonic acid, the authors having obtained pyrene ketone, $C_{14}H_6(CO)_2$, by distilling pyrenic acid with lime. This body crystallises from alcohol in satin-like gold-coloured plates, melting at 141°, and is probably formed by depriving pyrenic acid of two molecules of carbonic anhydride. It combines with phenylhydrazine, and dissolves in sodium bisulphite, forming a well-crystallised double salt from which the ketone may be recovered by the addition of an acid. The properties which characterise this body seem to prove that (1) pyrenic acid belongs to the class of ketonic acids, and that (2) its ketone group does not occupy the α -position to the carboxyl group, otherwise the body obtained by the removal of the carbonic anhydride elements should have exhibited the properties of an aldehyde.

By the action of potassium permanganate on pyrenic acid in the cold, a colourless acid is obtained, having the composition, $C_{14}H_6O_5$. The acid is tetrabasic, as proved by the constitution of its silver and barium salts, hence the formula, $C_{14}H_6O_5 = C_{10}H_4(COOH)_4$. The acid is resolved into naphthalene and carbonic anhydride when distilled with lime; it is therefore naphthalene-tetracarboxylic acid.—D. B.

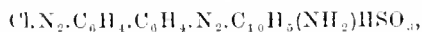
IV.—COLOURING MATTERS AND DYES.

Process for the Production of Mixed Azo-colours. Peter Jensen, London. From the "Actiengesellschaft für Anilinfabrikation," Berlin. Eng. Pat. 15,296, Dec. 12, 1885. 6d.

IN the specification claiming the production of "Congored" and analogous colouring matters (Eng. Pat. 4415,

* Referred to by Siemens: Discussion. Jour. Soc. Chem. Ind., 1885, 621.

1881; this Journal, vol. iv. 278), it is stated that the salt of tetrazodiphenyl must stand for twelve hours before complete combination with the naphthionic acid takes place. This is due to the fact that an intermediate compound of the formula—



is first produced, and this only combines slowly with the second molecule of naphthionic acid. The object of the present patent is to claim mixed azo-colours of the "Congo-red" type formed by the action of these intermediate compounds upon other amines, phenols, or sulphonic acids. All these colours dye cotton in an alkaline bath without the use of a mordant. As examples the patentees describe the preparation of the colours from (1) benzidine, naphthionic acid, and β -naphthylaminesulphonic acid, (2) benzidine, naphthionic acid, and metanaphthylsulphonic acid, (3) benzidine, naphthionic acid, and α -naphthylmonosulphonic acid, and (4) tolidine, naphthionic acid, and β -naphthylaminesulphonic acid. In these examples the order of combination may be reversed—i.e., the tetrazo-salt combined first with the second amine or phenol, etc., and afterwards with the naphthionic acid.—R. M.

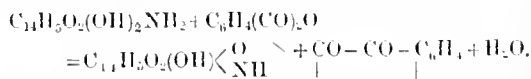
Mulhouse Industrial Society. Meeting 14th July, 1886.

(1.) *Schweinfurt Green.* S. Camille Koechlin.—It was observed fifty years ago by Ehrmann, that Schweinfurt green may be prepared by treating Scheele's green (copper arsenite) with acetic acid, copper acetate with arsenious acid, or any copper salt with an alkaline arsenite, and then with acetic acid. The author finds that an equally brilliant green may be prepared by substituting formic for acetic acid. A solution of 100grms. of copper sulphate in 500cc. of water is treated with 187.5cc. of sodium arsenite (500grms. per litre), and the precipitate is digested for an hour, at 40–50°, with 62cc. of acetic acid, of 7–8° B., or with 3lcc. of pure formic acid. In both cases a beautiful brilliant green is obtained. With half the quantity of formic acid a pale blue product is formed; but it is not produced under any circumstances by acetic acid. The author remarks that since the danger attending the employment of arsenic is now almost entirely removed, legislators are no longer justified in altogether prohibiting its use.

(2.) *Removal of Gum from Chocolate Mordants.* Oscar Scheurer.—The author states that he has succeeded in employing phosphorous or hypo-phosphorous acid in combination with a copper salt, in place of an alkaline arsenite, in the removal of gum from chocolate mordants. A number of specimens were printed with a chocolate containing 3 per cent. of metallic iron, fixed by contact with steam at 36–40°, for 12 hours, in the psychrometer, freed from gum with cow's dung and chalk, and dyed with alizarin. The specimens were as follows:—(1) chocolate; (2) the same with addition of 3grms. arsenious acid per kilo.; (3) the same as (1), with the addition of 20grms. phosphorous acid, of 16° B. per kilo.; (4) chocolate, with addition of 4grms. cuprous chloride per kilo.; (5) chocolate, with 3grms. arsenious acid, and 4grms. cuprous chloride per kilo.; (6) chocolate, with 20grms. phosphorous acid and 4grms. cuprous chloride per kilo. The best results were obtained with arsenic and copper combined, and then follow in order of efficiency—phosphorous acid and copper, arsenic alone, phosphorous acid alone, copper alone, and lastly, chocolate alone.

(3.) *Estimation of Antimony-potassium Oxalate.* —Setlicks. Communicated by Nölting.—This reagent has recently been employed for the fixation of tannin. A solution of the salt is treated with standard soda solution, until a slight turbidity is observed; the amount of free oxalic acid is thus indicated. Phenol-phthalein is added, and the soda solution run in until the solution becomes alkaline. The second quantity of soda is equivalent to the antimony oxide. The potassium is estimated by precipitating the antimony in a fresh solution with ammonia, filtering, evaporating to dryness, igniting, and titrating the alkaline carbonate with standard acid. The method is accurate.

(4.) *Derivatives of β -Amido-alizarin.* Prudhomme.—A new dye, which gives a brown-red colour with aluminium mordants, is obtained by the condensation of β -amido-alizarin with phthalic anhydride. The two bodies are simply heated together to 200°, without dehydrating agents; the product is taken up with soda, precipitated by hydrochloric acid, and washed. The colouring matter is yellow, but its alkaline solutions possess a very blue-violet colour, and do not deposit a coloured resin, like those of β -amido-alizarin. By the action of concentrated sulphuric acid, β -amido-alizarin is again formed. The reaction is probably analogous to the condensation of phthalic anhydride with ortho-amidophenols, the substance formed being phthalidyl amido-alizarin—



A similar colouring matter is obtained with acetic anhydride, but in this case the alkaline solutions are red. This body, ethenylamido-

alizarin, $\text{C}_{14}\text{H}_5\text{O}_2(\text{OH})\text{NH} \begin{array}{c} \diagup \text{CH} \diagdown \\ \text{NH} \end{array} \text{CH}_3$, has already been prepared by Römer, but its tinctorial properties have not been described by him.—S. Y.

Azo-Compounds. W. Staedel and H. Bauer. Ber. 19, 1952–1956.

For the easy and rapid production of *diazamidobenzene*, the author recommends the following process:—50 parts of aniline are dissolved in about 1500 parts of water and 15 parts strong sulphuric acid, the whole is cooled with ice to 27° C., and whilst at this temperature 18 parts of commercial sodium nitrite in solution are well mixed with it. In 30 minutes the yellow crystalline precipitate is filtered off, washed and dried at the ordinary temperature. The yield averages 97–98 per cent. of the theoretical quantity. The temperature of the mixture must not fall below 25° nor rise above 35°, otherwise the product will be impure.

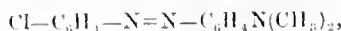
To obtain *amido-azobenzene*, the moist precipitate of diazo-amidobenzene is dissolved in two or three times its weight of aniline, with one-tenth of its weight of aniline hydrochloride, and the mixture heated for an hour to below 40°, and left to stand for 24 hours. Sufficient strong hydrochloric acid is then added, and on cooling, almost the theoretical quantity of amido-azobenzene crystallises out. Instead of first preparing the solid diazo-amidobenzene, the following process is recommended:—1mol. aniline hydrochloride is dissolved in 5–6mols. aniline, rather less than 1mol. of sodium nitrite is added, and well mixed at about 30–40° C. In about 12 hours the reaction is complete, and the amido-azobenzene can be obtained as above shown.

m-Nitrophenyl-azo-dimethylamidobenzene—



—10grms. dimethylaniline, 11.3grms. *m*-nitraniline, 4.5grms. sulphuric acid and 600–700cc. water are well shaken together, and being cooled to 27° C., are treated with 7grms. sodium nitrite in solution. In 30 minutes the reaction is ended, and the above compound is filtered off, washed, and dried. It crystallises from alcohol in small beautiful red brilliant plates, melting at 159–160°; it is sparingly soluble in all solvents. Strong reducing agents, such as zinc and acid, convert it into a mixture of *m*-phenylenediamine and *p*-amidodimethylaniline, which, on oxidation, yields a fine blue colouring matter, dyeing cotton and silk almost as well as methylene blue. When, however, the above compound is treated with the proper quantity of ammonium sulphide necessary to reduce the nitro group alone, this group is then not attacked, but the compound itself is split up into *m*-nitraniline and paramidodimethylaniline.

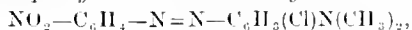
m-Chlorophenyl-azo-dimethylamidobenzene—



was obtained in a similar manner from *m*-chloraniline and

dimethylaniline. It is fairly soluble in alcohol, forming fine yellow leaflets melting at 98° C.

m-Nitrophenyl-azo-*m*-chlorodimethylanilindibenzene—



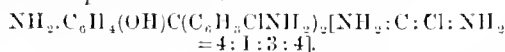
from *m*-nitraniline and *m*-chlorodimethylaniline. It crystallises from alcohol in small reddish-yellow plates, melting at 155–156° C.—T. L. B.

On the Influence on the Shade of Colouring Matters, caused by the Substitution of Elements and Radicals in their Molecules. Part I. K. Heumann and Th. Heidelberg. Ber. 19, 1989–1993.

IN many classes of colouring matters certain regularities are noticeable between their composition or constitution and the colour they dye. The authors consider the number of observations in this direction insufficient to formulate a general law, and in order to forego this, have studied the changes caused by the substitution of various elements and radicals in some of the more important coal-tar colours.

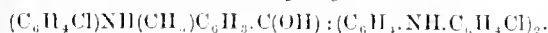
I.—The introduction of chlorine into the molecule of pararosaniline.—This can be done either by direct chlorination of the rosaniline, or by using chlorinated materials for the production of the rosaniline. The latter method was chosen, as it allowed the production of bodies of predetermined constitution. Thus a mixture of paratoluidine and chlorinated aniline would yield on oxidation a dichloropararosaniline, whilst chlorinated paratoluidine and aniline would form a monochloropararosaniline. Since, in order to form a rosaniline, the para position to the amido group must be readily available for the introduction of the methane carbon, those amines in which the para position is taken up by chlorine, should form no rosaniline at all, or only with difficulty. With this in view, mixtures of paratoluidine and ortho-, meta-, and para-chloraniline were oxidised by arsenic acid.

Dichloropararosaniline—



—20.9 grms. paratoluidine, 50 grms. orthochloraniline and 106 grms. 75 per cent. arsenic acid solution, were heated to about 190° C. until a sample showed no further change in shade. The melt was extracted with boiling water, the colouring matter thrown down with salt, filtered off, and redissolved in water, and from this solution the base precipitated with ammonia. After extraction with ether, the base was transformed into the hydrochloride, and this crystallised from alcohol. Dichloropararosaniline forms red flakes, soluble in alcohol, insoluble in water. With acids it forms beautiful bluish-red monacid salts; the acid salts are brown-yellow. The solution of the hydrochloride is decomposed on boiling, the base being partially precipitated. It dyes silk a blue-red shade, ordinary pararosaniline dyeing a yellowish shade. Its absorption spectrum, like that of rosaniline, shows a dark line between D and E, but rather nearer to D. Reducing agents form a leuco-base, forming a red, crystalline mass from alcohol. On heating with arsenic acid at 190°, 1 mol. paratoluidine and 2 mols. meta-chloraniline, or 1 mol. paratoluidine and 2 mols. parachloraniline, in either case no rosaniline was formed, the bulk of the meta- or otherwise parachloraniline remaining unaltered.

II.—The introduction of chlorine into the molecule of rosaniline-blue. *Trichlorotriphenylrosaniline*—



—Obtained by heating 10 grms. rosaniline, 100 grms. orthochloraniline, and 1.2 grms. benzoic acid together. It forms a red base, insoluble in water, which dissolves with a red colour in alcohol, the ether and benzene solutions being yellowish-brown. The hydrochloride is precipitated from alcohol as a dark blue powder, and dyes silk a blue violet, corresponding to methyl-violet 3B. With meta-chloraniline, a body was obtained similar to the above, but which dyes silk a much bluer shade, about 6B violet, whilst that obtained from para-chloraniline dyes a shade intermediate between these two.—T. L. B.

Action of Concentrated Hydrochloric Acid on Nitrosodimethylaniline. R. Möhlau. Ber. 19, 2010.

IF one part nitrosodimethylaniline hydrochloride be heated with 5 parts of conc. HCl gradually to 100–105°, the dark yellow solution changes to reddish-yellow, and after about a quarter of an hour the reaction is complete. On standing, colourless crystals separate out. This compound, when purified, has the composition and properties of dichloroparaphenylenediamine—(m.p. 164°). Bleaching-powder solution converts it into dichloroquinonedichlorodiamide. On adding conc. NaOH to the filtrate from the first reaction, a dark, heavy oil separates out, which can be fractionated without decomposition in *vacuo*, and has the composition and properties of dimethylphenylenediamine. This body, on oxidation, gives a corresponding quinone, and may be converted by the usual method into iodide of methylene-blue. That portion of the oil boiling above 258° gives, on oxidation, dichloroquinone. Treated with H₂S and then oxidised with Fe₂Cl₆, it yields the iodide of dichloromethylene-blue. It is therefore dimethyldiparachloroparaphenylenediamine. The action of hydrochloric acid upon nitrosodimethylaniline is one both of reduction and chlorination, according to the following equation:—
 $(\text{CH}_3)_2\text{N}\cdot\text{C}_6\text{H}_4\cdot\text{NO} + 4\text{HCl} = (\text{CH}_3)_2\text{N}\cdot\text{C}_6\text{H}_4\cdot\text{NH}_2 + \text{H}_2\text{O} + 4\text{Cl} = (\text{CH}_3)_2\text{N}\cdot\text{C}_6\text{H}_4\cdot\text{Cl}_2\cdot\text{NH}_2 + \text{H}_2\text{O} + 2\text{HCl}.$

—J. B. C.

The Dyeing Properties of the Benzidine Azo-Colours. Richard Möhlau. Ber. 19, 2014–2015.

UNTIL about two years ago, the only two known colouring matters which dyed cotton direct fast shades without mordants were turmeric and safflower. Since then, however, several red, yellow, and blue dyes have been introduced into the market under the names of Congo-red, benzopurpurin, chrysamin and benzo-azurine, all of which dye cotton without mordants. These colours are produced by the action of diazotised benzidine or toluidine, on naphthionic acid, α -naphtholsulphonic acid, β -naphthylamine sulphonic acid and salicylic acid; also on amido- and hydroxyl-derivatives of naphthalene sulphonic acid, and of *o*-oxybenzoic acid.

As bleached or oxidised cotton absorbs the dyes much better than the unbleached fibre, a certain amount of probability was given to the idea that oxycellulose was the cause of this behaviour, by forming insoluble, salt-like combinations with the amido and hydroxyl groups of these bodies. But, were this the case, it should hold good in the case of other colours of like constitution; but it does not do so.

The author is of opinion that the real cause of the affinity of the benzidine colours for cotton is the presence, in their molecule, of the paradiamidodiphenyl group, as bleached cotton can easily be mordanted with benzidine itself. If bleached cotton be boiled in an unsaturated aqueous solution of benzidine hydrochloride, then left to soak twenty-four hours, wrung out, dried at the ordinary temperature, and washed with hot and cold water, it will have become mordanted with benzidine. On cotton prepared in this way, the various benzidine colours may be developed by diazotising in an acidified solution of sodium nitrite, and subsequent warming or boiling in an alkaline solution of naphthionic or salicylic acid, etc.

—T. L. B.

Dinitronaphthylamine. O. N. Witt. Ber. 19, 2032.

IN order to prepare dinitronaphthylamine, the author acts upon dinitronaphthol, obtained from Martins yellow, with alcoholic ammonia in sealed tubes. The action begins at about 170°, and is complete after six to seven hours at 190–200°. The yellow crystalline contents are filtered and washed free from dinitronaphthol salts with boiling water. The substance has a melting-point of 239°. On nitrating acetnaphthalide, an acetyl compound (m.p. 247°) is obtained, from which the free base is separated by heating with alcoholic ammonia to 160°. After recrystallising from glacial acetic acid, it has a melting-point of 238–239°. This naphthylamine derivative appears, therefore, to be identical with that

obtained from dinitronaphthol. With aqueous potash the acetaido-group is replaced by hydroxyl and dinitronaphthol reproduced. On heating dinitronaphthylamine with alcoholic ammonia above 200°, it is converted into a yellow substance, which is soluble in aqueous ammonia, and behaves like a nitro-anidonnaphthol.—J. B. C.

Further Communications on Colouring Matters from Furfuraldehyde. Hugo Schiell. Ber. 19, 2153–2155.

In a previous paper (this Journal, 1886, 377), the author has shown that in the reaction between furfuraldehyde and aniline bases the aldehyde group only is attacked,

whilst the "Furan group" $\begin{pmatrix} \text{C}-\text{C} \\ | \quad | \\ \text{C}-\text{C} \quad \text{O} \end{pmatrix}$ remains intact.

The marked basic character of the compounds produced in the reaction, and the fact that in the numerous ways in which they can be decomposed no aniline base or furfuraldehyde is reformed, all point to the view that these colouring matters have a similar constitution to rosaniline, and are therefore derived from a *Furandiamidodiphenylmethane*, $\text{C}_6\text{H}_5\text{O}.\text{CH}(\text{C}_6\text{H}_4.\text{NH}_2)_2$.

Furfuralcohol, $\text{C}_4\text{H}_5\text{O}.\text{CH}_2\text{OH}$, is best prepared by the action of aqueous potash on furfuraldehyde—10cc. of the aldehyde to 5grms. KOH and 10cc. water. The crystals of potassium pyromucate are dissolved in the smallest quantity of water, the solution saturated with CO_2 and the furfuralcohol extracted with ether. This alcohol gives no colour reaction with amido-benzoic acid, β -naphthylamine, or sulphite of leucaniline. With a tolerably dilute solution of furfuralcohol, aniline gives rise to a yellow flocculent compound according to the equation $\text{C}_{11}\text{H}_{11}\text{NO} = \text{C}_6\text{H}_5\text{O}_2 + \text{C}_6\text{H}_7\text{N} - \text{H}_2\text{O}$. With such a solution, however, aniline hydrochloride forms a deep red solution, from which red-green crystals are deposited. These crystals have the composition $\text{C}_{11}\text{H}_{11}\text{NO}.\text{C}_6\text{H}_7\text{N}.\text{HCl}$, and contain one molecule of water less than the normal furfuraniline hydrochloride.

When phosphorus pentachloride (10grms.) is gradually added to ice-cold furfuraldehyde (3.9grms.) no violent reaction takes place. A dark-green solution is obtained, from which, however, it is impossible to separate the furfuraldichloride, $\text{C}_4\text{H}_3\text{O}.\text{CHCl}_2$.—T. L. B.

Bromo- and Nitro-derivatives of Azo Bodies obtained by Direct Substitution. J. V. Jamovsky and L. Erb. Ber. 19, 2155–2158.

By the action of bromine (1mol.) upon a warm acetic acid solution of azo-benzene (1mol.) a mixture of *o*-, *m*-, and *p*-monobromazo-benzenes, $\text{C}_6\text{H}_5\text{N}_2.\text{C}_6\text{H}_4\text{Br}$, is obtained, which are separated by their different solubilities in alcohol. By complete reduction they give aniline and *o*-, *m*-, or *p*-bromaniline.

o-Bromazobenzene crystallises from alcohol in glistening golden plates of melting-point 187° corr.; sparingly soluble in cold alcohol.

m-Bromazobenzene forms large orange-yellow plates; easily soluble in alcohol, and melts at 53–55°.

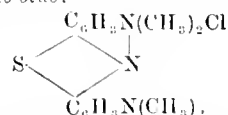
p-Bromazobenzene crystallises from alcohol, acetone, or ether in flat, brilliant, golden-yellow needles, melting at 85°. The corresponding hydrazo-compound forms glistening white needles.

By nitration of azobenzene in acetic acid solution, *o*-nitrozobenzene, $\text{C}_6\text{H}_5\text{N}_2.\text{C}_6\text{H}_4(\text{NO}_2)[1:2]$, is obtained. This compound is more soluble in alcohol, ether, and acetone than the para-compound, and melts at 130° corr. In common with other nitro-azo bodies, it gives a colour reaction (due to the formation of a nitrole) when partially reduced with ammonium sulphide in alkaline alcoholic solution. When its alcoholic solution, after addition of aqueous NaOH is treated hot with ammonium-sulphide, a green colouration is produced, whereas the para-compound under the same circumstances yields a blue. Another reaction for nitro-azo bodies consists in the formation of a violet or reddish-brown colouration when their solution in acetone is treated with a few drops of alcoholic KOH.—A. G. C.

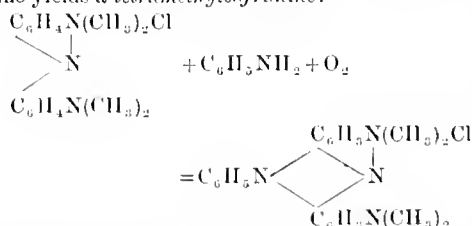
On Safranin and Methylene Blue. M. Andresen. Ber. 19, 2212–2217.

WHEN paradiamines are oxidised in the presence of aromatic monamines, blue oxidation products are formed, having, according to Nietzki (Ber. 16, 464), the following composition: $\text{ClR}_2\text{N}(\text{C}_6\text{H}_4)_2\text{N}.\text{C}_6\text{H}_4\text{NR}_2$,

where R equals hydrogen or an alkyl group. These compounds, when further oxidised in the presence of primary aromatic amines, yield members of the safranin class, very probably according to the equation: $\text{ClR}_2\text{N}(\text{C}_6\text{H}_4)_2\text{N}.\text{C}_6\text{H}_4\text{NR}_2 + \text{C}_6\text{H}_5\text{NH}_2 + \text{O}_2 = \text{C}_{18}\text{H}_{15}\text{N}_4\text{Cl} + 2\text{H}_2\text{O}$. In what way the second monamine combines with the intermediate blue product has not since then been elucidated. As a result of comparative studies of safranin and methylene blue, the author considers these two bodies to be intimately connected, and that since on oxidation in the presence of sulphuretted hydrogen Bindschedler's green is converted into methylene blue:

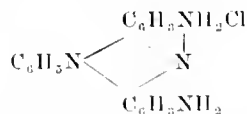


—so the same green on oxidation with a primary amine yields a tetramethylsafranin:



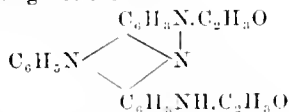
Safranin and methylene blue are alike in the following characteristics:—1. Both dissolve with a green colour in concentrated sulphuric acid, and the original colour returns on diluting the solution with water. 2. Both behave in the same way with alkalis, showing the equally stable combination of the chlorine molecule in each. 3. Both dye colours on wool which do not stand light, but are fast on cotton. 4. Both present great difficulty to the introduction of a sulphonic group. 5. Both require two molecules of hydrogen to reduce them to their leuco-compounds, which then most easily oxidise to the original body.

From the following facts the author considers this (*phenosafranin*) formula to be the correct one:



1. Given the right conditions of oxidation, almost theoretical yields are obtained from one molecule of paraphenylenediamine, one molecule of orthotoluidine, and one molecule of paratoluidine, which is added after the oxidation of the first two. The yield of colour is less, if aniline replaces the two monamines. 2. Besides the diamine two monamines are necessary. 3. The second monamine must be a primary one. 4. The combination with the second monamine takes place with the removal of four atoms of hydrogen. 5. Aniline, ortho- and paratoluidine and the xylylides, can be used as second amines, but para-toluidine gives the highest yield. As substitution in the nucleus of the second monamine does not interfere with the reaction, it shows the nucleus is not attacked. 6. The paradiamine may contain one dialkylised amido group, and the first monamine can also be dialkylised. 7. Tetramethylsafranin cannot be diazotised. 8. The two dimethylsafranins contain each one diazotisable amido group. 9. Phenosafranin only combines with one molecule naphthol after diazotation. 10. Diethylsafranin only forms a monacetyl compound, phenosafranin forming, however, a diacetylsafranin, from

which caustic alkali removes now the atom of chlorine with ease, setting free the base:



11. The second monamine in the safranines seems to enter into the ortho-position relatively to the nitrogen uniting the nuclei. The blue colours—toluylene blue—obtained by O. N. Witt, by oxidation of paradiamines with metadiamines, give rise on oxidation to a safranine. But as these blue compounds are only readily formed when the metadiamine has a para-position to one of the amido-groups free, one may assume the constitution of, for example, the leuco-compound of the blue obtained from dimethylparaphenylenediamine and metaphenylenediamine, to be: $(\text{CH}_3)_2\text{NC}_6\text{H}_4(\text{NH})\text{C}_6\text{H}_3(\text{NH}_2)_2$, $[\text{N}(\text{CH}_3)_2 : \text{NH} : \text{NH} : \text{NH}_2 : \text{NH}_2 = 5:2 \text{ and } 6:5:3]$; that is, that one amido group of the metadiamine occupies the ortho-position to the nitrogen uniting the nuclei, and that on oxidation to the safranine corresponding to it, this amine group enters into the corresponding ortho-position in the other nucleus. So that the constitution of the leuco-compound of Witt's toluylene-red would be expressed thus: $(\text{CH}_3)_2\text{NC}_6\text{H}_4 : (\text{NH})_2 : \text{C}_6\text{H}_3(\text{CH}_3)\text{NH}_2$, $[\text{N}(\text{CH}_3)_2 : \text{NH} : \text{NH} : \text{NH} : \text{NH}_2 : \text{CH}_3 = 5:2:3 \text{ and } 6:5:3:2]$. —T. L. B.

Synthesis of β -oreinol (p-Xyloreinol). H. v. Kostanecki. Ber. 19, 2318—2324.

THE " β -orein," isolated by Stenhouse and Groves from a few species of lichen, has never been obtained synthetically, nor its constitution determined. The author, in preparing the *m*-dioxy-*p*-xylene (*p*-xyloreinol), $\text{C}_6\text{H}_2(\text{CH}_3)_2(\text{OH})_2[1:4:3:5]$, finds that it is identical with β -orein. The method employed consisted in preparing the *m*-dinitro-*p*-xylene $\text{C}_6\text{H}_2(\text{CH}_3)_2(\text{NO}_2)_2[1:4:3:5]$ by nitration of *p*-xylene, reduction of this with alcoholic ammonium sulphide to *m*-nitro-*p*-xylylidine $\text{C}_6\text{H}_2(\text{CH}_3)_2(\text{NO}_2)\text{NH}_2[1:4:3:5]$, conversion into *m*-nitro-*p*-xylenol $\text{C}_6\text{H}_2(\text{CH}_3)_2(\text{NO}_2)(\text{OH})[1:4:3:5]$ by boiling the diazo-compound with water, reducing this with tin and HCl, and finally diazotising the *m*-amido-*p*-xylenol $\text{C}_6\text{H}_2(\text{CH}_3)_2(\text{NH}_2)(\text{OH})[1:4:3:5]$, and boiling the diazo-compound with water. The *m*-dinitro-*p*-xylene (m.p. 124°), *m*-nitro-*p*-xylylidine (m.p. 96°), and *m*-nitro-*p*-xylenol (m.p. 91°) have been previously described. *p*-Xyloreinol (β -orein) $\text{C}_6\text{H}_2(\text{CH}_3)_2(\text{OH})_2[1:4:3:5]$ has all the properties given by Stenhouse and Groves, with the one exception that it gives a green fluorescence when heated with chloroform and dilute NaOH, which, according to these authors, β -orein does not. It crystallises from water in well-formed prisms melting at 163°, and reddens in air containing NH_3 much more quickly than oreinol. By treatment with bromine in CS_2 solution it yields a *tetra*-bromo-*p*-xyloreinol $\text{C}_6\text{H}_2\text{Br}_4\text{O}_2$, and crystallises from petroleum ether in large tables of melting-point 101°. An aqueous solution of nitrosyl sulphate converts it into *nitroso-p*-xylorein $\text{C}_6\text{H}_2(\text{CH}_3)_2(\text{NO})(\text{OH})_2$, the properties of which are identical with the nitroso- β -orein. —A. G. G.

Creosol-carboxylic Acid. H. Wende. Ber. 19, 2324—2327.

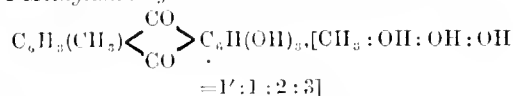
CREOSOL cannot be converted into its carboxylic acid by boiling with aqueous NaHCO_3 , but the author has prepared this acid by the action of CO_2 on the sodium compound. Four grams of sodium were gradually added to 50 grms. of crude creosols (fraction of beechwood creosote 219—224°), whilst a dry stream of CO_2 was passed in and the fluid gently heated. A vigorous reaction set in and the mixture became thick; the cooled product was acidified with dilute HCl and the oily layer treated with aqueous Na_2CO_3 to separate the carboxylic acid from unconverted creosol. The acid was precipitated from the soda solution by adding HCl. *Creosol-carboxylic acid* $\text{C}_6\text{H}_2\text{CH}_3(\text{OCH}_3)(\text{OH})\text{CO}_2\text{H}[1:3:4:5]$ crystallises in concentric needles melting at 180—182°; it is readily soluble in alcohol and ether,

sparingly in water, nearly insoluble in benzene. It sublimes undecomposed. With Fe_2Cl_6 it gives a deep blue colouration. The potassium salt forms readily soluble needles; the barium, lead, and copper salts are sparingly soluble. The *methyl ether* $\text{C}_6\text{H}_2\text{CH}_3(\text{OCH}_3)(\text{OH})\text{CO}_2\text{CH}_3$ forms small colourless trimetric crystals melting at 92°; it gives a bluish-green colouration with Fe_2Cl_6 . The *ethyl ether* $\text{C}_6\text{H}_2\text{CH}_3(\text{OCH}_3)(\text{OH})\text{CO}_2\text{C}_2\text{H}_5$ forms small needles or prisms melting at 77°. —A. G. G.

On the Methylanthragallols. Ernst L. Cahn. Ber. 19, 2333—2336.

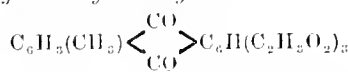
THERE are theoretically four methylanthragallols which can be formed by condensation of the three toluic acids with gallic acid. All four bodies resemble each other, and also anthragallol, very much; they are all readily soluble in alcohol, dissolve in hot ammonia with a blue, in strong alkalis with a green, and in dilute with a violet colour. Concentrated sulphuric acid dissolves them, forming a red solution, to which a drop of nitric acid gives a green colouration. This acid solution shows almost the same absorption bands as does that of anthragallol. They also give the same shades of colour with mordants as are obtained with anthragallol.

1-Methylanthragallol—



is obtained by heating for 12—15 hours 3 parts of ortho-toluic acid and 2 parts of gallic acid at a temperature of 130—135°. The best yield obtained was about 30 per cent. of the theoretical amount. It sublimes in orange-red needles melting at 297—298° with decomposition, and is soluble in hot water and acetic acid, insoluble in baryta-water.

Triacetyl-1-methylanthragallol—



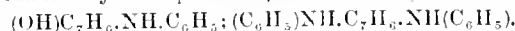
crystallises from acetic acid in sulphur-yellow tablets, melting at 208—210°. On distilling with zinc dust a hydrocarbon is obtained, melting at 197°, which on oxidation yields a quinone, melting at 278—279°.

3-Methylanthragallol [$\text{CH}_3 = 3'$] was obtained in a similar manner from para-toluic acid and gallic acid. It sublimes in small orange-red needles, melting at 275°. Its triacetyl compound forms nice yellow prisms from glacial acetic acid solution; it melts at 203—208°.

2- and 4-Methylanthragallols [$\text{CH}_3 = 2'$, and $\text{CH}_3 = 4'$]. — These two compounds are formed when meta-toluic acid is condensed with gallic acid. They are very difficult to separate from each other, the best way being repeated fractional crystallisation from alcohol of their acetyl compound. The one of these two bodies melts at 312—313°, and its acetyl derivative crystallises in needles melting at 188—190°. The other melts at 235—240°, and its acetyl compound forms small well-shaped prisms melting at 217—218°. —T. L. B.

The Action of Aniline on Oreinol. Zega and Buch. Journ. Prakt. Chem. 33, 1886, 547—548.

By the action of aniline and calcium chloride upon oreinol at 260—270°, phenyl-*m*-oxytolylamine is formed; with a mixture of zinc chloride and calcium chloride, the chief product is diphenyl-*m*-toluylenediamine, together with a small quantity of oxyamine; above 220° a quantity of a dark resinous product is formed. These compounds may be expressed by the following formulae:—



The yield of pure phenyl-*m*-oxytolylamine is about 50 per cent. of the theory; that of diphenyl-*m*-toluylenediamine, 30 per cent.

*Phenyl-*m*-oxytolylamine* crystallises from a mixture of benzene and petroleum ether in needles. Melting-point 79°. It dissolves in a small quantity of boiling water, readily in alcohol, ether, glacial acetic acid and benzene;

also in dilute potash and soda solution. The hydrochloride forms a white crystalline, easily decomposable powder. On heating with zinc dust the oxyamine is reduced to phenyl-*m*-tolylamine.

Diphenyl-m-tolylendiamine crystallises in indistinct needles, melting at 165° . It is soluble with difficulty in alcohol, ether, benzene, etc., in the cold; easily soluble on heating. The following compounds have been prepared:—Diacetyl compound— $C_{13}H_{16}(C_2H_3O)_2N_2$, m.p. = 160° ; dibenzoyl compound— $C_{13}H_{16}(C_7H_5O)_2N_2$, m.p. = 190° ; dinitroso compound— $C_{13}H_{16}(NO)_2N_2$, m.p. 170° ; dimethyl compound— $C_{13}H_{18}(CH_3)_2N_2$, m.p. = 124° . On adding a nitrite to a solution of the diamine in concentrated sulphuric acid the latter is coloured violet, and afterwards violet blue; with nitric acid or a nitrate it turns directly violet blue. The lemon-yellow nitroso compound gives a dark violet in contact with concentrated H_2SO_4 .—J. B. C.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Absorption of Dye-stuffs by Living Cells. W. Pfeffer. Chem. Zeit. 10, 1259.

It has previously been supposed that dye-stuffs do not penetrate into living cells; the author, however, shows that aniline dyes, such as methyl violet, methylene blue, rosaniline, etc., can be fixed upon living cells, while others, such as aniline blue or nigrosin, are not effective. The dye-stuff must be used in very dilute solution, 1 in 1000, for example. In many plants, tannic acid, and in others, substances of unknown composition, serve to retain the dye. Thus, either a precipitate is produced, or the dye remains dissolved in the cell contents. Methylene blue passes by exosmosis through the protoplasm of the cells without colouring it, while methyl violet, cyanine, etc., impart a more or less decided tinge. The dye-stuff can be removed by very dilute citric acid, which decomposes the tannate, and then the citrate formed is removed by exosmosis.

—V. H. V.

Improvements in the Production of Azo Colours on Cotton or other Vegetable Fibre. T. Holliday, London. Eng. Pat. 13,790, Nov. 12, 1885. 6d.

THE inventor has found that oxide of lead or the compounds formed by oxide of lead and oily bodies, which compounds he calls "lead soaps," when fixed on cotton or other vegetable fibre will take up alpha- or beta-naphthols from mixtures of those naphthols with, or their solutions in, water, and his method has for its object the utilisation of this action for the purpose of fixing azo colours on cotton or other vegetable fibres, either in a raw state, spun, woven, or otherwise manufactured. For this purpose he employs a weak solution of oxide of lead in caustic alkali, and "lead soap" is formed by passing the cotton through a weak solution of soluble soap or oily emulsion, either before or after passing it through the solution of oxide of lead. The cotton is then ready for the formation of such azo colours as are formed by any suitable process. Other methods of fixing oxide of lead may be used, such as passing the fibre through a solution of a lead salt, then through caustic soda solution, which fixes the lead oxide, and then through a solution of soap, when lead soap will be fixed.

—J. H.

Improvements in the Construction of Apparatus for Scouring, Washing, and other Analogous Purposes. R. H. Ainsworth and S. B. Manby, London. Eng. Pat. 14,031, Nov. 17, 1885. 8d.

THIS relates to a method for scouring, washing, dunging, dyeing and similarly treating cloth or woven fabrics by the combined agency of liquor and steam, water and steam, or dye liquor and steam.

The apparatus consists of two tanks, one inside the other, the inner one being inverted and fixed to the outer casing in such a way as to leave cavities at each end for the passage of cloth into and from the same. Internally the tank is fitted with top and bottom friction rollers, the bottom ones being immersed in liquor or water, the upper ones being in the space allotted to steam.

When steam is admitted into the apparatus, the liquor or water from the bottom end rises in separate columns up the cavities at each end, sufficiently to balance the pressure of steam employed, which causes the liquid in the internal part of the tank to fall to a lower level than when admitted, and ensures scouring, washing, or otherwise by the combined action of liquor, or water and steam alternately. The novelty of this invention is that cloth is passed through liquor, water, or dye liquor into steam, in which it is operated upon by the squeezer rollers. Thus the cloth is subjected to the action of steam whilst scouring, washing, dyeing, dunging and during the other operations. After this it is redipped or drawn through the liquor or water, and the steaming and squeezing operation repeated alternately or otherwise until the end of the tank is reached, when the cloth is passed through the liquid in the outer cavity, from whence it is passed through another pair of squeezer rollers to remove the surplus liquid, and return it to the tank by the outlet cavity.—J. H.

Improvements in or applicable to Machinery for Scouring and Washing Wool and other Fibrous Materials. J. McNaught and W. McNaught. Eng. Pat. 14,168, Nov. 19, 1885. 8d.

THIS invention relates to the mechanism for squeezing the moisture from wool or fibrous material, fed to the machine from a washing trough.

In the ordinary machine great expense is caused by the repeated renewal of the fibrous material with which the upper roller is covered, the wear and tear arising to a great extent from the frictional action of the lower or driving roller upon it, the bearings of the covered roller having in the ordinary arrangement to be of large diameter to resist the heavy strain put upon the journals by the weighting arrangement. The improvement consists of a combination of anti-friction bowls with weighted levers in such a way that the levers do not act directly upon the axle bearings of the upper roller, but upon the axles of the anti-friction bowls, which bowls press upon and revolve with the axle of the upper roller and rise and fall with it. The anti-friction bowls are carried by a shaft or axle, having bearings upon which the weighted levers press. The weighted levers have their fulcrums in the framing, as in the ordinary arrangement of levers and rods hitherto used for weighting fibrous-covered rollers directly. The axle of the upper roller is or may be guided and held laterally in place by vertical guides in the framing, or anti-friction bowls may be arranged at the sides of the axle to take the lateral pressure and hold it in position.

With this arrangement the friction is considerably reduced, and there is less slipping tendency between the squeezing rollers, and consequently less wear and tear upon the fibrous-covered roller.

A further improvement consists of an arrangement for heating the scouring or washing liquor, and applies to a machine where the water squeezed from the wool is collected and returned by a pipe to a trough from which it is elevated by buckets of a revolving wheel back to the washing trough. Steam is admitted into the pipe or cavity connected with the pipe bringing the liquor from the squeezing rollers to the trough for the elevator, by which arrangement the liquor is heated as it passes along the pipe.—J. H.

Improvements in Detergents and Dyes. C. P. Andersen, Denmark. Eng. Pat. 8528, June 29, 1886. 4d.

HEMATEIN is prepared by mixing hematoxylin, derived from logwood, with ammonia, and oxygenating the

mixture in air. This is used as a detergent and dye, with or without soap, and with or without a decoction of "quialaire" bark.—W. L. C.

VII.—ACIDS, ALKALIS, AND SALTS.

A New Process for the Production of the Alkali Metals.
H. Y. Castner, New York. Abstract from a Paper read before the Chemical Section of the Franklin Institute, October 12, 1886.

THE process consists in reducing either the hydrate or the carbonate of an alkali, when in a fused state, by the "carbide" of a metal. By the latter is meant an intimate mixture of carbon and iron, produced by coking a mixture of tar and iron in a fine state of division. Such proportions of tar and iron are used as will produce, when the mass is coked, a metallic coke, containing 70 per cent. of iron and 30 per cent. of carbon— FeC_2 . This compound, after being ground, is ready for use in the process, based upon the reaction which is expressed by the following formula:— $3\text{NaOH} + \text{FeC}_2 = 3\text{Na} + \text{Fe} + \text{CO} + \text{CO}_2 + 3\text{H}$. The reduction of the mixture of "carbide" and alkaline hydrate is carried on in large cast-iron crucibles, in a furnace, the heating space of which is divided into separate chambers. An aperture is provided at the bottom of each chamber, through which the crucible may be raised by mechanical means into its position in the furnace. The necessary cover for the crucible is fixed stationary in each chamber, and from this cover projects a tube to the outside of the furnace, into the receptacle for the condensation of the metallic vapours. The edges of the covers are made convex, while the edges of the crucibles are concave, so that the edges form a tight joint when the crucibles are pressed upwards. The furnace is heated by gas, and the reduction and distillation of the sodium commences at 1000°C . As soon as the operation is finished, the crucible is lowered, and a new one containing a fresh charge raised in its place, thus making the process practically continuous. The crucibles after treatment contain a small amount of sodium carbonate, and all the iron of the "carbide" in a fine state of division. The residue is, therefore, treated with warm water, to recover the sodium carbonate, while the iron is dried, mixed with tar, and coked to produce more of the "carbide".—S. H.

Specific Gravities of Different Salts and Solutions. G. Gerlach. Chem. Ind. 9, 241—245.

THE specific gravities of the salts were determined by comparing their weight in the air with that of an equal volume of petroleum, the sp. gr. of the latter being 0.8024 at 19.5°C , water of 19.5°C . being 1; and 0.8015 at 19.5°C , water of 4°C . being 1.

SP. GR. OF SOME COMPOUNDS AT THE TEMPERATURE OF 19.5°C . THE WEIGHT OF AN EQUAL VOLUME OF WATER AT 4°C . BEING 1.

Fused potassium acetate.....	CH_3COOK	1.170
Crystallised potassium acetate ..	$\text{CH}_3\text{COOK} + \text{H}_2\text{O}$	1.415
Neutral potassium tartrate	$\text{K}_2\text{C}_4\text{H}_4\text{O}_6$	1.912
Anhydrous potassium-sodium) tartrate	$\text{KNaC}_4\text{H}_4\text{O}_6$	1.911
Crystallised potassium carbonate	$\text{K}_2\text{CO}_3 + 2\text{H}_2\text{O}$	2.013
" " "	$\text{K}_2\text{CO}_3 + \text{H}_2\text{O}$	1.997
Crystallised Manganese Sulphate	$\text{MnSO}_4 + 4\text{H}_2\text{O}$	2.107
Anhydrous sodium thiosulphate..	$\text{Na}_2\text{S}_2\text{O}_3$	1.667
Crystallised calcium nitrate	$\text{Ca}(\text{NO}_3)_2 + 2\text{H}_2\text{O}$	2.000
Crystallised sodium hydrate.....	$(\text{Na}_2\text{O})_2 + 3\text{H}_2\text{O}$	1.829
Crystallised potassium hydrate ..	$\text{K}_2\text{O} + 3\text{H}_2\text{O}$	1.987

POTASSIUM ACETATE.

100 parts of the solution contain parts by weight.	Sp. gr. of solutions at 17.5°C , water at 17.5°C . being 1.
0	1.0000
10	1.0490
20	1.1005
30	1.1515
40	1.2105
50	1.2685
60	1.3285
Saturated solution (mother-liquor).	1.4300

SODIUM ACETATE.

100 parts of the solution of the crystallised salt contain parts by weight	100 parts of the solution of the anhydrous salt contain parts by weight	Sp. gr. of solutions at 17.5°C , water of 17.5°C . being 1.
0	0	1.000
5	3.015	1.015
10	6.030	1.031
15	9.045	1.047
20	12.060	1.063
25	15.075	1.0795
Saturated solution (mother-liquor).		1.170

POTASSIUM TARTRATE.

100 parts of the solution contain parts by weight.	Sp. gr. of solutions at 17.5°C , water at 17.5°C . being 1.
0	1.0000
10	1.0650
20	1.1350
30	1.2110
40	1.2900
50	1.3815
Saturated solution (mother-liquor).	1.496

POTASSIUM-SODIUM TARTRATE.

100 parts of the solution of the crystallised salt contain parts by weight	100 parts of the solution of the anhydrous salt contain parts by weight	Sp. gr. at 17.5°C , water at 17.5°C . being 1.
0	0	1.0600
10	7.418	1.0510
20	14.836	1.1050
30	22.254	1.1620
40	29.672	1.2230
50	37.090	1.2890

ALUMINIUM-POTASSIUM SULPHATE (POTASH ALUM).

100 parts of the solution of the crystallised salt contain parts by weight	100 parts of the solution of the anhydrous salt contain parts by weight	Sp. gr. at 17.5° C., water at 17.5° C., being 1.
0	0	1.0000
4	2.1792	1.0205
8	4.3584	1.0415
12	6.5376	1.0625
13	7.0821	1.0630

AMMONIUM NITRATE.

100 parts of the solution contain parts by weight.	Sp. gr. at 17.5° C., water at 17.5° C., being 1.
0	1.0000
10	1.0125
20	1.0260
30	1.0310
40	1.0390
50	1.0300
60	1.0285
Saturated solution (mother-liquor).	1.0050

CALCIUM NITRATE.

100 parts of the solution of the crystallised salt contain parts by weight.	100 parts of the solution of the anhydrous salt contain parts by weight.	Sp. gr. at 17.5° C., water at 17.5° C., being 1.
0	0	1.000
10	8.2	1.059
20	16.4	1.124
30	24.6	1.195
40	32.8	1.272
50	41.0	1.355
60	49.2	1.445

OXALIC ACID.

100 parts of the solution of the crystallised acid contain parts by weight.	100 parts of the solution of the anhydrous acid contain parts by weight.	Sp. gr. at 17.5° C., water at 17.5° C., being 1.
0	0	1.000
2	1.4281	1.007
4	2.8568	1.011
6	4.2855	1.021
8	5.7136	1.028
10	7.1420	1.035
12	8.5704	1.042
13	9.2816	1.0455

—S. H.

Conditions necessary for the Complete Elimination of Arsenic from Hydrochloric Acid by means of Sulphuretted Hydrogen. R. Otto. Ber. 19, 1903—1910.

FROM a series of experiments on the presence of minute quantities of arsenic in hydrochloric acid, the author infers that even the pure acid of commerce, denoted as free from arsenic, contains traces of this element, and should therefore not be employed in forensic examina-

tions for metallic poisons. It was found that on treating "pure" hydrochloric acid with sulphuretted hydrogen it was not possible to remove the last traces of arsenic; if, however, the acid is first mixed with a small quantity of ferric chloride, potassium dichromate, mercuric chloride, cadmium sulphate, copper sulphate, sulphurous acid, or even arsenious acid, the whole of the arsenic can be removed by means of sulphuretted hydrogen. The author has found that commercial hydrochloric acid (crude) can be readily freed from arsenic by the following method: After diluting the acid with water to a specific gravity of 1.12, the solution is saturated with sulphuretted hydrogen. It is then allowed to remain quiescent in a closed vessel for 24 hours at 39–40°, after which it is again treated with sulphuretted hydrogen, and the operation repeated until the acid assumes a permanent odour of sulphuretted hydrogen. The solution is allowed to settle, decanted, filtered, and distilled until one-tenth remains in the retort. It is best to reject the first portions of the distillate containing the sulphuretted hydrogen.—D. B.

Improvements in the Manufacture of Sulphide of Zinc. J. B. Spence, London. Eng. Pat. 13,462, Nov. 6, 1885. 4d.

AN iron vessel is filled with a strong solution of a caustic alkali, and metallic zinc, in the form of plates, suspended in this solution. The zinc is then brought into metallic contact with the iron of the vessel in any convenient manner; this produces galvanic action, and causes the rapid dissolution of the zinc. Sodium or potassium sulphide is added to the solution, and the precipitate of zinc sulphide thus obtained allowed to settle. The supernatant liquor, consisting of either sodium or potassium hydrate, is decanted and used over again for dissolving another lot of zinc.—S. H.

Improved Apparatus for the Manufacture of Chlorine Gas. H. H. Lake, London. From Count R. de Montgas, Philadelphia, U.S.A. Eng. Pat. 10,009. August 4, 1886. 6d.

THE patent relates to an apparatus for making chlorine on a small scale. It consists of an earthenware pot, the cover of which may be clamped down, and which is provided with a perforated tray. The pipe for the acid supply passes to the space below the tray, while another pipe issuing from the top carries away the gas generated. There is also an arrangement for running off the liquid contents of the vessel.—S. H.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

The Hydraulic Properties of Cements. E. Michel. Jour. Prakt. Chem. 1886, 33, 548–558.

THE author has made a series of tests with a view of determining the proportions of silica to lime and of silica to alumina required to produce the most effective hardening properties in hydraulic cements. He found that when gelatinous silica, previously dried at 110°, was mixed with very finely-powdered calcium hydrate, moistened with the smallest quantity of water, the proportions being 1mol. silica to 1½mols. calcium hydrate, a cement was produced which in a fortnight could not be scratched with the finger-nail. A mixture of gelatinous silica, pure sand, and lime also gave satisfactory results. The author confirms Fuch's theory—viz., that the silicic acid is essential to the hardening process. The latter is also dependent upon the addition of lime, on the density and thorough mixing of the materials, and upon the amount of water in the mixture.

Alumina forms a cement with lime only when dried at 110° before mixing, negative results being obtained with strongly-heated or gelatinous alumina. The method of Frühling was found to give good results. This consists in well incorporating the respective substances in a mortar, enclosing them in a wrapper of filter-paper, and then allowing the whole to become moist under water. Alumina, under these conditions,

combines with lime to form a cement. Contrary to the opinion of Winkler, Heldt, and Fremy, alumina is not the only essential binding ingredient in cements. The author finds that gelatinous and strongly-heated silica, as well as the dried substance, mixed with lime, and placed in filter-paper under water, forms a hard, solid mass after some time. Silica and alumina have no action upon each other. From these experiments it follows that both silica and alumina have cementing properties; but, whilst the alumina hardens quickly and produces the first adhesion of the mixture, the silica acts more slowly, and produces subsequent hardening. The lime has a double part to play: in the first place, it combines with silica and alumina; in the second place, it has a protective action on these bodies by forming on the surface a layer of calcium carbonate. It has been found, practically, that the necessary amount of lime is much smaller than the calculated quantity; for, with 1 mol. of silica, a sixteenth mol. calcium hydrate was sufficient to produce hardening. The author, in order to determine the actual chemical change in cement, has made a series of analyses showing the composition of cements after hardening. He finds that the amount of calcium carbonate varied from 14 to 33 per. cent., and of silicates from 4 to 10 per cent. These results agree with experiments which show that a much smaller proportion of calcium is necessary than is requisite to combine with the whole of the silica and alumina present. The author explains this by the supposition that the particles on hardening become covered with a coating of silicates of lime and alumina which bind them together, and this view explains also the fact that Portland cement after hardening, when re-burnt and re-pulverised, may be used again, fresh surfaces being exposed. The results of these experiments may be summed up shortly as follows:—The hardening depends on: The amount of water, which must be as small as possible, and regularly distributed. The density and thorough mixing of the materials. The formation of calcium carbonate. Further, the necessary amount of lime is comparatively small. The three principal constituents, SiO_2 , Al_2O_3 , and CaO , are chemically active. The alumina produces rapid, silica slow hardening. The chemical action is mainly a surface one. The alkalis are not essential constituents.—J. B. C.

Improvements in the Manufacture of Cement. W. T. Timewell, Devon. Eng. Pat. 11,806, Oct. 3, 1885. 6d.

THE object of the inventor is to make cement from hard limestones which contain over 60 per cent. of carbonate of lime. The limestone is first reduced to an impalpable powder. Any silicious aluminous material—e.g., fine clay, porcelain clay, or river mud—is mixed with silica and alumina so that the percentage of the former in the mixture shall be from 58 to 68 per cent., and that of the latter from 18 to 24 per cent.; it is then reduced to an impalpable powder. A slurry of the two, powdered limestone and the silicious matter, is made, dried, and furnace in the usual way. The proportions used should be from three to five parts of carbonate of lime to one part of silica and alumina. The patentee also finds in the preparation of the finely-ground materials it is more convenient to use a blast of air in conjunction with subsiding chambers to eliminate the coarse particles than it is to use sieves.—C. C. H.

Improvements in the Manufacture of Lime Cement applicable to the Production of Cements, Mortars, and Hydraulic Concretes, and Artificial Stone replacing Natural Stone. S. Pitt, Sutton, Surrey. From A. Speyser and L. Pillivayt, Paris. Eng. Pat. 12,908, Oct. 27, 1885. 6d.

SLAKED and crushed "fat lime" is mixed with crushed dried clay, 2 to 4 volumes of the former to 7 to 9 volumes of the latter; the whole is thoroughly incorporated with water into a paste and moulded into bricks, which are subsequently dried and crushed into grains about the size of a pea. The grains are furnace in rotating cylinders from 10 to 18 hours, and when cool reduced to an impalpable powder. From 1 to 3 volumes of powdered fat lime are finally mixed with the powder above

described, the product forming a good hydraulic cement. The latter addition may be made at any time, the two materials being kept separate until the cement is required for use.—C. C. H.

Improvements in the Manufacture of Composition adapted for Use in Mural and other Decorations, and in the Method of Producing the said Decorations. R. Bennett, Manchester; and H. Peet, Nottingham. Eng. Pat. 13,132, Oct. 31, 1885. 6d.

THIS invention relates to an improved composition suitable for application to walls, ceilings, etc., and particularly adapted to receive decorative impressions immediately after its application and whilst in a soft condition. The following materials, in the proportions indicated, are used in the manufacture of the composition in question:—Common whiting, 40 parts; plaster of Paris, 6 parts; glue, 3 parts; and molasses, 3 parts. Dry or moist colour or oil paint may be added. When the composition has been laid on, and is still soft, it is treated with suitably-formed combs, stamps, rollers, or blocks, by the application of which sunk or relieved decorations may be produced upon the soft surface.—E. G. C.

Improvements in Manufacturing Artificial Stones or Marbles. A. G. Brookes, London. From R. A. Meyn and J. F. O. Arnack, Hamburg. Eng. Pat. 13,595, Nov. 9, 1885. 6d.

VERY FINE CEMENT is mixed with barytes, the paste being tinted by any suitable mineral colour. For the production of imitation marble or granite, a convenient number of pastes of different colours are made by mixing the prepared and coloured cement with water, then dividing such pastes in pieces of small size when granite is to be imitated, and in pieces of large size for imitating marble. Dry cement of different colour is spread over these moist lumps, and the whole mass is then well kneaded, care being taken that the coherent nature of the lumps is maintained. After a few days, when the stones are somewhat hardened, they are shaped by means of suitable shaping tools.—E. G. C.

Improvements in the Manufacture of Cement. H. Mathey, New York. Eng. Pat. 7674, June 8, 1886. 4d.

ARGILLACEOUS LIME-STONE, commonly called "natural cement rock," used in the production of cement, by simply burning the natural mineral, does not contain sufficient alumina to form the double silicates of lime and alumina for the requirements of a high-class cement. The patentee effects the introduction of this alumina into the cement as follows:—The "cement rock" is reduced to a fine state of division, so as to pass through a four to eight mesh screen; dried crushed clay is added, the mixture agitated, furnace, and crushed to an impalpable powder, all in the manner usual in the production of Portland cement.—C. C. H.

Notes on Cement. Diagl. Polyt. J. 261, 529–541.

C. SCHUMANN (*Deutsche Bauzeitung*, 1886, 14) compared cement made from basic blast-furnace slag, erroneously termed "Puzzolan cement," with Portland cement, and finds the latter preferable for all the usual purposes. Puzzolan cement hardens very slowly, and its final hardness is inferior to that of Portland cement, which latter also offers greater resistance to the passage of water through it. Cement made from slag may be used as an addition to lime-mortar, the quality of which is thereby improved, but its admixture to Portland cement deteriorates the quality of the latter.

Tetmaier (*Schweizer Bauzeitung*, 1886, Nos. 14–17) examined slag cement, as regards its formation and applicability. He finds that to increase its cohesive power it is very important to granulate the slag before mixing it with lime. This is probably owing to the change of position the molecules undergo, when the hot slag is suddenly cooled by being thrown into water. The slag also loses thereby a small portion of its sulphur, and part of the silica is rendered soluble.

must, therefore, not be used if the temperature is below freezing point. Its principal applicability is for building under water or in a moist atmosphere, the lime then being gradually dissolved, in which state it acts on the slag, combining with silica. Its property of setting slowly is, therefore, due to the gradual action of the lime as it dissolves. For surface building the mortar must be kept moist for the first fortnight at least. Unfortunately the mortar from slag-cement is liable to shrink. F. M. Meyer (*Thonindustrie Zeitung*, 1885, 515, and 1886, 101) compared the working of an annular kiln with that of a Dietzsch cement-furnace. The fire-gases of the former contain on an average 6.2 per cent. carbon dioxide. 1734kilos. of cement are obtained per hour with a consumption of 238kilos. of coke and 109kilos. of coal. 41 per cent. of the total heat generated escapes with the fire-gases, the temperature of which is 232° C. Each kilo. of cement requires 835 calories. In a cement furnace 2070kilos. of coal are consumed for the production of 16,000kilos. of cement. The combustion is more perfect, the temperature of the fire-gases is 102° C., and each kilo. of cement only requires 710 calories. The cement-furnace is, therefore, more economical for burning cement than the annular kiln.

Another mortar, prepared with one equivalent of alumina and two equivalents of lime, tested five months after preparation:—

Dissolved in the Ammonium Chloride Solution.	(Combined Water	13.53
	Calcium Carbonate	19.72
	Lime	58.83
	Alumina	1.31
	Calcium Aluminate	2.39
Residue.	Impurities (Sand)	0.10

	No. 1. Annealed.	No. 2. Annealed.	No. 3. Tempered in oil and annealed dark red.
Elastic limit per sq. mm.	10.2 kilos.	10.3 kilos.	110 kilos.
Ultimate tensile strength per sq. mm.	73.0 "	70.8 "	150 "
Elongation, per cent.	17.9	21.2	6.2
Relation of ruptured to original section ..	0.308	0.333	0.708

—W. G. M.

A Portland-cement mortar, several years old, tested:—

Dissolved in the Ammonium Chloride Solution.	(Combined Water	9.29
	Soluble Silica	1.90
	Alumina and Iron Peroxide ..	5.47
	Lime	30.51
	Calcium Carbonate	23.07
	Insoluble Residue	9.14
	Aluminium Silica	2.09
Residue.	Calcium .. Aluminium and Iron Peroxide ..	3.43
	Silicate .. Lime	1.80
	Alkalis and Loss	4.27

It therefore appears that from a chemical point of view only a small quantity of the materials used in the preparation of cement-mortar is instrumental in the setting, which does not appear to be due to any chemical process. The amount of new compounds formed is very small indeed, and this also accounts for the fact that old cement-mortar, burned and powdered afresh, recovers the property of setting and hardening.—S. H.

X.—METALLURGY, Etc.

On Chrome Pig-iron and Steel. M. Brastlein. Iron and Steel Inst. Oct. 1886.

CHROMIUM—like manganese, but in a much higher degree—favours the combination of carbon with the metal; but the ferro-chromes, unlike ferro-manganese, never crystallise in large plates, but rather as needles, or with small facets, and a much larger quantity of chromium (sixty-five per cent.) is necessary to destroy the magnetic properties of the iron. In ferro-chromes the chromium is readily oxidised on heating, and since it remains infusible *per se*, and its silicate is also refractory, it follows that chromium-pig cannot be puddled,

nor can it be used as a substitute for ferro-manganese in the Bessemer or open-hearth processes; and, similarly, chrome-steel cannot be welded, whilst the metal, when melted, retains the earthy oxide produced on exposure to air, forming veins which no amount of forging can remove. Nevertheless, a good chrome-steel may with care be produced, the percentage of chromium employed being capable of considerable variation; a metal with two per cent. carbon and twelve per cent. chromium may be forged well. In steel, chromium increases the tenacity without affecting the percentage elongation under strain, but chrome-steel is always harder under the tool, though less so than one with an equivalent proportion of manganese. Chromium-steel tempers equally well with ordinary steel, but the temper penetrates deeper, owing probably to the tendency of chromium to combine with carbon; before tempering, the fractures are almost alike, the former being slightly more fibrous, but after tempering it becomes much finer, those richer in chromium resembling tungsten steel. If overheated, the chrome alloy becomes brilliantly crystalline and brittle, but it is less easily burnt than manganese-steel. Under the hammer it behaves like a carbon-steel of similar quality, though somewhat harder when cold drawn; worked hot, it is inferior to a manganese-steel. The hardening power of the metal suggests its use in the form of chromium-pig for rolling-mills and the like; but, if so employed, the carbon percentage should be small, in order to prevent the brittleness induced by much of that element. Bars turned to 9mm. diameter, with a length of 75mm. between the shoulders, gave the following tests by tensile strain:—

Some Preliminary Experiments on the Removal of Metalloids in the Basic Siemens Furnace. F. W. Harbord. Iron and Steel Inst. Oct. 1886.

THREE experiments with metals of known composition were made in a five-ton circular Batho furnace with a basic lining and suspended roof, samples of metal and of slag being taken for analysis immediately on complete melting, and at half-hour intervals subsequently until the end of the operation. In each case the charge consisted of sixty per cent. pig, thirty per cent. steel scrap, and three per cent. spiegel. The pig used in the first two trials had the following composition:—

	C	Si	P	Mn	S
White pig	2.61	1.27	3.50	0.31	0.31
Mottled	3.20	1.50	3.80	0.50	0.23

The scrap being chiefly lalle and hammer scrap. In the course of melting, which occupies four hours, slags very rich in protoxide of iron are formed; and by contact with these the metal is deprived, by the time it has completely run down, of over ninety-eight per cent. of the silicon, ninety-three per cent. of the manganese, and forty per cent. of the phosphorus, it originally contained, together with eighty-one per cent. of the carbon, and a very small percentage of the sulphur. In the third experiment, which was made with a low grade pig, containing 0.488 per cent. of sulphur, the slag formed during melting contained from 52 to 63 per cent. of ferrous oxide, and the metal was found to be almost completely freed from carbon, silicon, phosphorus, and manganese, though the sulphur, which was finally reduced to 0.20 per cent., had been scarcely affected. On comparison with the curves representing the removal of the metalloids in the other decarburising processes commonly employed, the curve obtained from these experiments approaches most nearly

A Method of Lining Furnaces. F. Siemens, London. Eng. Pat. 14,142, Nov. 18, 1885. 6d.

THE interior of the furnace is heated to the softening point of the bricks, and the lining material, in a pulverulent condition, is introduced into an air or steam injector, and thus directed through suitable doors or holes against such portions of the walls or roof as require to be lined; the dust adheres at this point, and by alternate heating and injection the lining may be thickened as required.

—W. G. M.

Regenerative Gas-furnace for Continuous Reduction of Iron Ore. F. Siemens, London. Eng. Pat. 14,143, Nov. 18, 1885. 8d.

THE furnace is of rectangular form, with all the gas and air ports at one end, one set being above or at the side of the other, so that the flame and heated gases sweep completely round the chamber. The opposite end of the furnace is inclined upward to the roof, through an opening in which the ore, mixed with reducing material and flux, is continuously fed on to the slope; here reduction is effected, and the metal is melted by the radiant heat of the flame, the molten iron collecting in a deep well situated at the regenerator end. The slag is drawn off continuously, and the metal at intervals, through tap-holes, of which several are provided at different levels in the sides of the furnace.—W. G. M.

Improvements in the Production of Aluminium and Aluminium-bronze. R. Grätzel, Bremen. Eng. Pat. 14,325, Nov. 23, 1885. 6d.

ALUMINIUM may be obtained from the double fluoride of aluminium and sodium or potassium by fusion with metallic magnesium, or by conducting magnesium vapour into the liquid compound; or it may be reduced electrolytically by a current of comparatively low tension if magnesium chloride be present. If a suitable proportion of copper be added in any of the above processes, aluminium-bronze will be produced. Barium, strontium, or calcium, if their cost were not prohibitory, could be substituted for magnesium; a salt of either of these metals may be employed in place of one of magnesium for the electrolytic method.—W. G. M.

Improvements in the Manufacture of Chloride of Aluminium and Double Chloride of Aluminium and Sodium. H. H. Lake, London. From Count R. de Montgela, Philadelphia, U.S.A. Eng. Pat. 10,011, August 4, 1886. 4d.

ALUMINIUM OXIDE, in the form of powder, is mixed with an equal weight of sodium chloride and of powdered charcoal, worked into lumps with molasses, dried, and ignited at a white heat in closed crucibles. These lumps are heated in dry chlorine for 16–18 hours, when aluminium chloride distils over, aluminium-sodium chloride being left in the retorts. The sodium chloride may be omitted or replaced by sodium carbonate.—W. G. M.

Improvements in Apparatus for the Manufacture of Chloride of Aluminium and Double Chloride of Aluminium and Sodium. H. H. Lake, London. From Count R. de Montgela, Philadelphia, U.S.A. Eng. Pat. 10,013, August 4, 1886. 6d.

SER in a brick chamber, fired by an oil spray, are horizontal retorts, each surrounded by an iron jacket and communicating behind with a condensing chamber for collecting the volatile chlorides; a perforated tube is passed into the retorts for chlorine delivery. Above, and set in the brickwork, are retorts for drying the charge before chlorinating.—W. G. M.

An Improved Process of Extracting Aluminium from Chlorides of the same, and of Aluminium and Sodium. W. R. Lake, London. From Count R. de Montgela, Philadelphia, U.S.A. Eng. Pat. 10,605, August 18, 1886. 4d.

TO a melted mixture of aluminium chloride and aluminium-sodium chloride granulated zinc is added, and the

whole well fused; an alloy containing 50 per cent. of aluminium may thus be made. This alloy is remelted with fresh double chloride and a small proportion of magnesium. The resulting alloy may, if wished, be still further enriched by a repetition of the process, or it may at once be fused with "muriate of potassium" and sodium chloride in equal quantities, by which the zinc will be removed from the alloy.—W. G. M.

An Improved Process of Extracting Aluminium from its Chlorides. W. R. Lake, London. From Count R. de Montgela, Philadelphia, U.S.A. Eng. Pat. 10,606, August 18, 1886. 4d.

THE chloride is mixed with lead oxide, charcoal, and sodium chloride, fused, crushed, and remelted with magnesium filings and "muriate of potassium." The mass, on cooling, is pulverised, re-fused with fresh "muriate" and nitrate of potash, poured into water, and the globules of aluminium separated.—W. G. M.

XI.—FATS, OILS, AND SOAP MANUFACTURE.

An Improved Process for Improving or Increasing the Viscosity of Oils. Wm. and H. Marriott. Eng. Pat. 11,726, Oct. 2, 1885.

THE "brown grease" recovered from the wash-waters of woollen factories is distilled with superheated steam, and the best portion of the distillate is completely saponified by soda. The soap is then treated with alum, a mixture of aluminium stearate and oleate being thus formed, which is purified by washing and is finally dehydrated. This "viscom" is added to mineral lubricating oils to increase their viscosity.—W. L. C.

Improvements in the Manufacture of Candles, and Apparatus therefor. G. A. Sweetser, D. W. Bell, and W. Bolun. Eng. Pat. 13,417, Nov. 5, 1885. 8d.

THIS specification explains in detail, with the aid of drawings, apparatus by which candles may be moulded from plastic material in the solid condition, instead of the material being melted and poured into moulds as usual. The moulds, through which a continuous wick runs, are connected with a cylinder and piston which, in their turn, are in communication with a reservoir of the candle material. The latter is thus forced through the moulds, cut off to any desired length, and then trimmed and pointed by suitable machinery.—W. L. C.

Improvements in the Manufacture of Soap for Toilet and Cleansing Purposes. R. Ross. Eng. Pat. 14,380, Nov. 24, 1885. 4d.

ORDINARY SOAP is dissolved in water, about 6 per cent. of carbonate of potash (salts of tartar) are added, and about four times that quantity of methylated spirits. The whole is boiled for five minutes, and formed into bars or tablets as desired.—W. L. C.

Improvements in Apparatus for Extracting or Separating Oil or Grease from Cotton Waste and Similar Materials. J. Whittle. Eng. Pat. 8924, July 8, 1886. 8d.

THE apparatus is arranged in three tiers: (1) top tier, consisting of two vessels to hold the substance to be treated; (2) condensing coils leading into small reservoir; (3) large reservoir for hydrocarbon. In operating, hydrocarbon vapour, driven by steam out of the lowest reservoir, condenses like dew in the substance to be extracted, and the solution of grease produced therein drains back into the lowest reservoir. Both the recovered grease and the material whence it was extracted are freed from hydrocarbon by steaming in the usual way. A drawing of the arrangement is given.—W. L. C.

Improvement in Lubricating Compounds. J. L. Mott, jun. Eng. Pat. 8933, July 8, 1886. 4d.

SIXTY POUNDS paraffin wax and 100lb. tallow are melted together, 210lb. refined petroleum oil are added, and 1½lb. refined plumbago are then incorporated with the mixture, which is then cooled off for use.—W. L. C.

Improvements relating to the Bleaching of Fats and Oils. H. H. Lake. Eng. Pat. 9415, July 20, 1886. 4d.

FINELY-POWDERED FULLER'S EARTH is well mixed with the oil, which should not be heated (as it usually is); after some hours' subsidence, clear bleached oil is drawn off. A "Johnson" filter, and steam, are employed to remove the last traces of oil from the Fuller's earth. —W. L. C.

An Improved Antiseptic Soap. J. Thomson. Eng. Pat. 9591, July 24, 1886. 4d.

BINODIDE OF MERCURY (usually dissolved in iodide of potassium) is incorporated with soap, in the proportion from 0.01 per cent. to 1 per cent.—W. L. C.

Improvements in the Manufacture of Soap. H. H. Lake. From N. J. Clute, P. B. Rose, and J. M. Aubery, Chicago, U.S.A. Eng. Pat. 10,226, August 10, 1886. 4d.

THE tank water formed in the "rendering" of lard, tallow, or other fats, is evaporated to a syrupy consistence, then holding in solution 20 per cent. of solids, about one-fifth of which is nitrogenised substance furnishing ammonia. This is saponified in the usual way with tallow and rosin: "100lb. of tank water after being reduced 50 per cent. by evaporation, 90lb. tallow, 15lb. resin, with an amount of caustic soda sufficient to render saponification complete."—W. L. C.

XII.—PAINTS, VARNISHES, AND RESINS.

The Manufacture of a Composition suitable for making Wall Coverings, Boiler Coverings, and other Fabrics, Moulded Articles, and other uses. W. Clark. From E. D. Fagnet, France. Eng. Pat. 10,492, Sept. 4, 1885.

To a mixture of equal parts of linseed and some other oil, from 15 to 40 per cent. of calcium carbonate is added, and then from 10 to 30 per cent. of chloride of sulphur. The paste thus obtained is ground up with cork, sawdust, etc., and is then spread upon canvas or some other foundation.—W. L. C.

Improved Compound for the Manufacture of Pigments and as Material for the Manufacture of Articles usually made of Clay. A. J. Ward, Westminster. Eng. Pat. 10,838, Sept. 12, 1885. 6d.

THE inventor claims:—1. "The combination of mica, or clay, and oxide of lead, either with or without slate debris, as a compound or body for the manufacture of pigments, applicable also to the purposes for which white lead is ordinarily used." 2. "The combination of slate debris and mica, or clay; or slate debris, mica, and clay, as a material for the manufacture of articles usually made of clay."—E. G. C.

Improvements in the Manufacture of Waterproof Cloth, Felt, Board, Paper for Roofing, Packing, and Insulating Purposes. J. E. A. Pierret, Belgium. Eng. Pat. 13,140, Oct. 31, 1885. 6d.

THE petroleum residues are first neutralised with lime. The waterproofing compound is obtained by melting together a variable quantity of the residual matter obtained from the refining of petroleum with natural dry bitumen, resin colophony and Spanish white or lime stone. There are five claims to this patent.—E. G. C.

Improvements in the Preparation of Materials to be used in Making Paint. J. B. Spence, London. Eng. Pat. 14,128, Nov. 18, 1885. 6d.

THE inventor prepares sulphide of zinc and sulphate or carbonate of barium in the following manner:—Metallic zinc is dissolved in a solution of caustic alkali, and sulphide of barium is added to the product. Sulphuric or carbonic acid is now introduced, the result being a deposit or precipitate consisting of sulphide of zinc and sulphate or carbonate of barium. This precipitate is dried, and is then ready for use as a body or base for paint. —E. G. C.

A New Varnish and a Method of applying the same for Fixing Lithographic or other Transfers. C. F. Rousset, Paris. Eng. Pat. 606, Jan. 14, 1886. 6d.

THE new varnish is composed of:—Heavy benzene, 760—860grms.; Judaea bitumen (mineral pitch), 90—120grms.; and essence of copaiva, 7—20 drops. For the mode of application the specification must be consulted. —E. G. C.

XIII.—TANNING, LEATHER, GLUE, AND SIZE.

Improvements in the Process of and Apparatus for Tanning Leather. E. Edwards, London. From Charles Kollen-Corneille, Rheims. Eng. Pat. 14,414, Nov. 24, 1885. 8d.

THIS invention is for improvements in tanning-drums. By means of two wooden brackets on each side of the interior of the drum, a movable platform is fixed to facilitate the introduction and withdrawal of the leather from the drum. To facilitate the tanning of flanks or pieces of much greater length than breadth, the drum is divided in the centre by a transverse partition. The axes of the drum are hollow, so that by suitable appliances, fresh air, or the gases from the interior of another drum, can be aspirated through the drum while working. A tap is placed on the circumference of the drum by which samples of the liquor can be taken. After each tanning operation the liquor is filtered, and to prevent the injurious effect of the frothing of the liquor in the drum, "raw pulverised borax," in small quantity, is added. —B. H.

Improvements in and relating to Machines for Putting Out and otherwise Treating Hides and Skins. Joseph Warren Vaughn, Massachusetts, U.S. Eng. Pat. 5344, April 16, 1886. 11d.

THIS is a machine for "striking," setting or "putting out" hides or skins, and it can also be used for unhairing or fleshing. The hide or skin to be operated upon is put on a holder which, when raised, brings it into contact with two rolls. These rolls are each provided peripherally with a series of spirally arranged flanges made of iron, and revolve in opposite directions. The speed of the rolls and the pressure put on them, and also the speed of the holder, can be varied according to the class of work done. For details of the mechanism the bluebook must be consulted. There are seventeen claims to the patent.—B. H.

A New Product for Depilating and Preserving Hides. A. H. Mangin, Paris. Eng. Pat. 7145, May 27, 1886. 4d.

IN this invention a mixture of caustic soda and sulphhydrate or mono-sulphide of sodium is used. The proportions of the ingredients used and the strength of the liquor may vary within wide limits, according to the nature of the hides to be treated.—B. H.

An Improved Composition for Treating Leather and Leather Articles. T. N. Ashman, Bristol. Eng. Pat. 8413, June 26, 1886. 4d.

THIS composition consists of "asphalte" melted with cod or other fish, animal, or vegetable oil, beeswax, spermaceti,

or other wax, litharge, and linseed oil well boiled, terebene, or other dryers, Venice turpentine, ground mica or asbestos mixed with gum damar dissolved in alcohol, dry white lead, and gutta-percha or indiarubber dissolved in any of the usual solvents. For medium tanned leather about equal proportions of the ingredients are to be used. The leather is to be either immersed in the melted composition or the composition can be applied by means of a brush, or otherwise, to one side.—B. H.

XIV.—AGRICULTURE, MANURES, Etc.

Influence of the Protoxide of Iron in Basic Cinder on the Growth of Plants. Dr. J. M. H. Munro, College of Agriculture, Downton, Salisbury.

THIS report contains experiments supplementary to those which form the subject of the abstract following this. Seeds of various sorts—barley, white turnips, clover, white mustard, garden cress—were sown in mixtures of garden soil with basic cinder, in order to ascertain whether the large proportion of protoxide of iron in the basic cinder exercises any unfavourable influence on germination or growth. In order to put this question to the severest possible test, enormously exaggerated doses of basic cinder were employed—viz., 10 per cent. of the mixed soil, 25 per cent., 50 per cent., and pure basic cinder without any soil. Most of the seeds tried germinated even in the pure basic cinder, and some of the plants lived until starved for want of nitrogenous food. All the other mixtures produced plants which flowered and seeded in due course. The barley plants in the mixture of equal parts of basic cinder and garden soil were actually better than those grown in garden soil alone. These plants produced full ears of grain of unimpaired germinating power.

As basic cinder is an alkaline substance, containing free lime, it is only natural that in the three stronger mixtures fewer seeds germinated than in the weaker mixtures or garden soil alone. The conclusion arrived at by the author is that the ferrous oxide contained in basic cinder is absolutely without injurious influence on either germination or growth.—J. M. H. M.

Report of Experiments on the Manurial Value of Basic Cinder. J. Wrightson and Dr. J. M. H. Munro, College of Agriculture, Downton, Salisbury.

THE basic cinder employed in these experiments (1885) was produced by the Thomas process at the works of the North-Eastern Steel Company, Middlesborough. The sample employed, which was rather poorer in phosphate of lime than that now being produced, had the following composition:—CaO, 41.54; MgO, 6.13; Al_2O_3 , 2.60; FeO, 14.66; Fe_2O_3 , 8.64; MnO, 3.81; V_2O_5 , 0.29; SiO_2 , 7.40; P_2O_5 , 14.32; SO_3 , 0.31; S, 0.23—99.93.

Ohlendorf & Co. This precipitated phosphate contained 30.89 P_2O_5 , with 29.91 CaO , 3.62 Fe_2O_3 , 7.53 SiO_2 , 18.72 water and moisture, etc. The P_2O_5 in this product is practically all soluble in ammonium citrate.

Duplicate series of experiments were made on soils of totally different character—a thin light chalky soil on the Wiltshire Downs (College of Agriculture Farm), and a deep stiff clay soil at Ferryhill, Durham. The Downton soil had been somewhat heavily cropped during the last few years, and the Ferryhill soil had received no manure for many years.

Duplicate plots of each dressing were employed at both stations; the number and arrangement of the plots, and the kind and quantity of manure used on each, were exactly the same at Ferryhill as at Downton. At each station there were 35 plots, each 1 chain square, or $\frac{1}{16}$ th acre, and these were so arranged as to permit a comparison of every manured plot with one or more *adjacent* unmanured plots. The special comparisons between the different manures were also obtained from *adjacent* plots. There were six unmanured plots at each station. The crop grown at Downton was swedes, and at Ferryhill yellow Aberdeen turnips; the season, being very dry, was a disastrous one for root crops over the greater part of England, and the crops obtained on the experimental plots were very much below average in consequence. Notwithstanding this, the effect of the different manures is shown in a most striking manner, as will be seen from the few selected results which follow. Twenty-four out of the thirty-five plots at each station were devoted to a comparison of the raw ground basic cinder, with the manures already named, and with the six unmanured plots. These plots when weighed up gave the results as in Table I.

On the unmanured plots at Ferryhill, the young plant was unable to struggle through the early stages of its existence, and to withstand the attack of the "fly"—hence the very small number of roots that came to maturity. On the Downton unmanured plots there was no extensive failure of the plant, but the roots were extremely small. The manured plots gave the mean yields and increases over the mean of the six unmanured plots as shown in Table II.

These results place beyond all doubt the manurial value of the phosphoric acid contained in basic cinder. They also exhibit pretty clearly its relative efficacy as compared with the phosphoric acid in superphosphate, precipitated phosphate, and ground mineral phosphate; and they indicate the differences that may be expected from the use of basic cinder on soils of different qualities.

The general conclusion deducible from these experiments is that phosphoric acid exists in basic cinder in a condition to be easily assimilated by plants, and that in this respect it resembles soluble phosphoric acid and precipitated phosphoric acid much more than the insoluble phosphoric acid of ground mineral phosphates;

TABLE I.

	DOWNTON.		FERRYHILL.	
	No. of Roots.	Weight.	No. of Roots.	Weight.
		Cwt. qr. lb.		Cwt. qr. lb.
Mean yield of the 6 unmanured plots per $\frac{1}{16}$ acre	2360	6 0 11	362	2 2 7
Mean yield of 2 plots receiving 45lb. Basic Cinder (=1cwt. per acre)	2570	11 0 17	1970	13 3 0
Increase on $\frac{1}{16}$ acre over unmanured plots		5 0 3		11 0 21

This ground cinder was tried side by side with ground Cambridge coprolites containing 25.1 per cent. P_2O_5 , mineral superphosphate of ordinary quality containing 12.0 per cent. soluble P_2O_5 , rich (Curacao) superphosphate containing 20.1 per cent. soluble P_2O_5 , and also with precipitated phosphate of lime prepared from the basic cinder itself by Scheibler's process, and sold by

hence it is likely to occupy a very important position as a phosphatic manure. In the two years 1884 and 1885, there were no signs of injury to the crop, even from the heaviest dressings of basic cinder—viz., 1 and 2 tons per acre. On poor pasture land, also, dressings of basic cinder were found to produce large increases in the hay crop.

According to one of these patents (Munro and Wrightson, Eng. Pat. 250, 1885), ground basic cinder is used as a precipitating agent for the soluble phosphoric acid of rich superphosphate, and by mixing the two substances in suitable proportions, a manure of moderate richness is obtained, free from any excessive proportion of oxides of iron, and containing phosphoric acid in three highly-assimilable forms—viz., soluble, precipitated, and "cinder" phosphoric acid. The experimental plots on which this manure was tried show that the efficacy of the soluble phosphoric acid was not weakened by

on the dose, a small quantity being sometimes beneficial, and a large quantity invariably noxious. On the experimental plots to which the "dissolved cinder" was applied, the effect appeared to be uniformly disadvantageous. The dissolved cinder in all cases had *some* manurial value, giving increases over the unmanured plots; but these increases were *less* than were obtained with the same quantity of cinder not dissolved by acid, so that the sulphate of iron appears to have neutralised a part of the benefit derived from the phosphoric acid.

—J. M. H. M.

TABLE II.
DOWNTON.

No.		PER PLOT (½ ACRE).	
		Mean Yield.	Increase.
		Cwt. qr. lb.	Cwt. qr. lb.
1.	2cwt. Basic Cinder (=320lb. P_2O_5 per acre)	15 3 5	9 2 20
2.	54lb. Superphosphate (=65lb. P_2O_5 per acre)	15 0 1	8 3 15
3.	53lb. Precipitated Phosphate (=109lb. P_2O_5 per acre)	13 1 6	7 0 20
4.	45lb. Superphosphate (=4cwt. per acre, containing 54lb. P_2O_5 per acre)	12 0 11	5 3 25
5.	45lb. Basic Cinder (=4cwt. per acre, containing 64½lb. P_2O_5)	11 0 17	5 0 3
6.	28lb. Rich Superphosphate (=56lb. P_2O_5 per acre)	10 2 19	4 2 15
7.	17lb. Precipitated Phosphate (=33lb. P_2O_5 per acre)	9 3 27	3 3 13
8.	78½lb. Basic Cinder (=7cwt. per acre, containing 112lb. P_2O_5)	8 3 19	2 3 5
9.	45lb. Coprolites (=4cwt. per acre, containing 112lb. P_2O_5)	6 1 16	0 1 2
10.	Unmanured	6 0 11	—

FERRYHILL.

No.		PER PLOT (½ ACRE).	
		Mean Yield.	Increase.
		Cwt. qr. lb.	Cwt. qr. lb.
1.	54lb. Superphosphate (=65lb. P_2O_5 per acre)	16 3 0	14 0 21
2.	2cwt. Basic Cinder (=1 ton per acre, containing 320lb. P_2O_5)	14 3 21	12 1 14
3.	45lb. Basic Cinder (=4cwt. per acre, containing 64½lb. P_2O_5)	13 3 0	11 0 21
4.	33lb. Precipitated Phosphate (=109lb. P_2O_5 per acre)	13 1 14	10 3 7
5.	78½lb. Basic Cinder (=7cwt. per acre, containing 112lb. P_2O_5)	12 3 22	10 1 15
6.	28lb. Rich Superphosphate (=56lb. P_2O_5 per acre)	12 3 14	10 1 7
7.	45lb. Superphosphate (=4cwt. per acre, containing 54lb. P_2O_5 per acre)	11 3 14	9 1 7
8.	17lb. Precipitated Phosphate (=33lb. P_2O_5 per acre)	11 3 0	9 0 21
9.	45lb. Coprolites (=4cwt. per acre, containing 112lb. P_2O_5)	11 0 7	8 2 0
10.	Unmanured	2 2 7	—

partial precipitation, and that the cinder phosphoric acid in the mixture exercised a manurial effect over and above that due to the phosphoric acid of the superphosphate. The manufacture of a soluble phosphate from basic cinder itself has also been tried and patented (Munro, Eng. Pat. 7740, 1885). When treated with the proper quantity of sulphuric acid, basic cinder is converted into a light green, dry, friable, and very porous substance, containing a large proportion of sulphate of lime, soluble phosphate of lime, and about 12 per cent. of crystallised green vitriol (a portion of the phosphoric acid exists as *soluble ferrous phosphate*). In view of the recent experiments of Griffiths, it was thought that the sulphate of iron contained in this manure might exert a beneficial effect on vegetation, instead of being, according to common belief, an absolute poison. The effect of ferrous sulphate on vegetation seems to depend entirely

On the Use of Gypsum and Related Substances in Preventing Loss of Ammonia from Liquid Manure. Adolf Mayer. *Journ. f. Landw.* **34**, 121.

THE author has arrived at the following conclusions:—The addition of a quantity of gypsum to liquid manure, equivalent to the ammonia present, is not sufficient. There must be so much that the liquid is always saturated with calcium sulphate. Nessler has shown (*Jahresber f. Agriculturchemie*, 1862, 157) that 5 equivalents of gypsum are required. The gypsum should be finely divided and well mixed with the manure. The best plan is to mix the gypsum intimately with the solid dung, and to bring the liquid repeatedly in contact with this by means of pumps. The availability of other sulphates depends on the formation of an insoluble carbonate or hydrate by the action of the ammonia. Ferrous

sulphate is considerably better than gypsum, but is more expensive. Potassium sulphate cannot be employed on account of the solubility of potassium carbonate. The whole of the ammonium carbonate is not converted into sulphate, and as the unaltered carbonate volatilises, the chemical equilibrium is constantly being restored by reconversion of ammonium sulphate into carbonate. Magnesium sulphate is not suitable owing to the formation of soluble double salts.—S. Y.

XV.—SUGAR, GUMS, STARCHES, Etc.

Manufacture of Sugar. Zeits. Deutschen Vereins für Rübenzuckerind., 1886, 489.

THE following were communicated to the annual meeting of the above Society:—

Hellriegel investigated the necessary amount of nitrogen necessary for the growth of the sugar-beet, and found that in the presence of sufficient phosphoric acid and potassium each kilo. of soluble nitrogen produced 220 kilos. of beet, yielding 32 kilos. of sugar. The strength of the beet was not appreciably influenced by the addition of a large amount of soluble nitrogen.

Schulz and *Schultze* contributed papers on buying beets on a basis of the amount of sugar they contain. They conclude that it is necessary to take 20 to 30 roots for the determination of sugar, in order to arrive at a correct result.

Landolt considers that Fahlberg's saccharine will have no influence on the sugar industry, and that starch-sugar sweetened with saccharine will never displace cane and beet-sugar.

Sichel modifies his former method for polarising cane-sugar, molasses, etc., with alcohol, by first adding acetic acid to decompose the alkaline sucrates present, and which would be precipitated by the alcohol.

Degener has investigated the different defecating agents used in determining the value of beet-juice, and finds that an examination of beet-juice and the impure products is not possible without the use of alcohol. Glutamine and glutamic acid become strongly levo-rotary by the inconsiderate addition of lead acetate. By the use of alcohol alone in examination of beets, too high a polarisation is generally obtained, which is lessened by the addition of a few drops of lead acetate, and the filtration of the separated precipitate. It is not quite determined in what way the precipitated compound acts, but a considerable error results if this slight addition of lead acetate is omitted. *Degener*, therefore, in examining beets and beet-juice, adds 5 drops of lead acetate solution to each 100cc. of the juice, after it has been treated with alcohol in the usual manner, quickly filters off the precipitate, and examines the solution with the polariscope. In examining impure products, and especially molasses, by this method, it is necessary to add a larger quantity of lead acetate. 20 drops are necessary for molasses, and it is preferable to use a 100mm. tube for polarisation than to add a larger quantity of lead acetate. The error is less in the former case than in the latter. Potassium acetate does not affect the rotation of sugar.

Herzfeld has studied the use of peat in place of animal charcoal. He finds that it decolourises better than the latter, and also reduces the amount of ash, but communicates colour to an alkaline solution, and is, therefore, not to be recommended.

Franken recommended the use of acid sulphite of aluminium for purifying beet-juice. The sugar obtained by means of this reagent should be free from invert sugar.

Sternberg brought forward the results of carrying out Steffen's method for separating sugar from molasses. By this method it was possible to obtain more than 88 per cent. of the sugar contained in the beet—a beet containing 11.985 per cent. sugar, yielding 11.115 per cent. of the finished sugar; and from molasses containing 50 per cent. sugar, 45.22 and 44.45 per cent. pure sugar were obtained.

Degener discussed the influence on the amount of invert sugar of the alkalinity of the beet-juice. He considered that it increased the keeping qualities, but caused an after colouration.

Degener also recommended Soldaini's reagent for detecting the presence of invert sugar. This is prepared by adding a solution of 40grms. of crystallised sodium carbonate to 40grms. of copper sulphate in solution. The precipitated basic copper carbonate is filtered off, and gradually added to a concentrated solution of 416grms. of bicarbonate of potassium. The solution is then made up to 1400cc., warmed for 2 hours on the water-bath, and filtered from the undissolved portion of carbonate of copper. The reagent so prepared is a deep blue liquid of 1.185 sp. gr. This solution should give no reduction on boiling, either alone or with cane sugar, for 5 minutes over a naked flame; and 0.0014gm. qualitatively, invert sugar can be determined by using 50cc. of the reagent, with certainty. In presence of cane sugar the delicacy is greater, it being then possible to detect 0.005 per cent. of invert sugar in cane sugar. Ammonia or ammonium salts diminish the reducing action of invert sugar.

Bodenbender contested the possibility of determining 0.05 per cent. invert sugar. All sugars reduce Fehling's solution slightly, and thus interfere with the estimation of small amounts of invert sugar.—G. H. M.

Treatment of the Waste Acid Liquor from Starch Factories. R. Schütze. Landw. Vers. St. 33, 197.

IN factories where starch is made by the acid process, it is proposed to render the residual liquors harmless from a sanitary point of view by heating them in a wooden tank to 60–70° C., by means of the waste steam from the engines, stirring in a slight excess of thick milk of lime, and then neutralising with more of the acid liquor. The precipitate settles quickly, and the clear liquor is then run off, and may be used for manuring purposes, whilst the sediment may be pressed in cloths or mixed at once with other food for pigs. The process is recommended for large factories, as the amount of lime, time and labour required is very small.—E. E. B.

XVI.—BREWING, WINES, SPIRITS, Etc.

Determination of the "Dry Extract" in Wines. E. Bouillon. Compt. Rend. 103, 498.

THE author has found from numerous experiments that when wine is evaporated in vacuo, any increase in the area of the surface of the liquid causes considerable diminution in the weight of the extract, owing to the volatilisation of some of the glycerine. Details of some of the experiments are given. When the bottom of the evaporating basin is covered with a layer of sand (5mm. deep), the loss is still more marked. To obtain comparative results, it is recommended to use basins with flat bottoms, of the same diameter, and to always take the same volume of wine for each experiment. (See Nessler u. Barth, *Zeit. f. Anal. Chem.* 23, 323–332.)

—E. E. B.

On the Employment of Fuel in Breweries. W. Goslich. Wochenschr. f. Brauerei, 1886, 3, 546.

As a result of the inquiry held by the Brewing Institute in Berlin, the author states that the quantity of coal employed in different breweries per ton of malt differs far more than is generally supposed. For the kiln-drying and boiling processes, $56.6 + 94.7 = 151.3$ kilos. of coal per 100 kilos. of malt are, on the average, employed. The extremes are $32.5 + 50 = 82.5$ and $90.5 + 162 = 252.5$ kilos. of coal per 100 kilos. of malt. To these numbers must be added the amount of coal required for other purposes—for instance, that employed in steam breweries for heating the ovens and engine boilers. For a copper heated by steam, about 50 kilos. of coal per 100 kilos. of malt are required. Of 100 parts of coal employed for brewing purposes (total amount without copper), 62.5 parts go to the brewing house and 37.5 to the kilns; including fuel for coppers, the proportions are, 47.0 parts to the brewing house, 28.1 to the kilns, and 24.9 to the coppers.—S. Y.

Improvements in the Preparation of Finings for Clarification of Beers and Wines. F. Keeling, London. Eng. Pat. 15,168, Dec. 10, 1885. 4d.

THE patentee claims the use of a 0.1 per cent. solution of sulphuric acid, or a 0.2 per cent. solution of hydrochloric acid, for dissolving the isinglass.—G. H. M.

Improvements in the Distillation and the Rectification of Alcoholic and other Liquids. L. Béchaux, Porrentruy, Switzerland. Eng. Pat. 9630, July 26, 1886. 8d.

THIS is an apparatus in which the liquid to be distilled or rectified is led through a vertical flat coil heated to the required temperature by means of a water-bath. The flat pipes of the coil work independently of each other, owing to hydraulic joints, and the vapours formed in each flat are successively passed through analysers and refrigerators, which are kept at the temperature required for rectification by means of vapour circulating through a coil. The original must be consulted for full description and drawings. The patentee claims that good alcohol, free from essential oils, etc., can be obtained by a single distillation.—G. H. M.

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

(A) CHEMISTRY OF FOODS.

Inorganic Foods. N. A. Randolph, M.D. Jour. Franklin Inst. 122 [729], 177.

THE author demonstrates the physiological value of water and certain inorganic salts—*e.g.*, those of sodium, potassium, and calcium—as food-stuffs. In the adult, from 59 to 65 per cent. of the weight of the body is water, and defective nutriment increases this amount. Farinaceous materials as food impart an appearance of plumpness by favouring the accumulation of water in the tissues. The chemical reactions which occur in the body require the presence of a certain quantity of water, and it is most essential to the healthy action of the nervous and muscular functions. Certain diseases—*e.g.*, cholera—diminish the percentage of water in the tissues. On the other hand, starvation does not decrease its quantity, because the destruction of the albumens sets free their water of combination; hence, combined hunger and thirst are better endured than either alone. Increased consumption of fluid only temporarily increases the quantity secreted by the tissues. In growing children, an increased consumption of water is necessary to wash away the products of tissue-change.

To the healthy physiological condition certain solid inorganic foods are essential, and their presence seems essential to the integrity of proteid matter, and inorganic salts appear to enter into combination with the albumenoids. Starvation results in the elimination of inorganic salts—those set free in the destruction of the albumens—and the administration of foods free from salts results in an almost complete absence of salts in excretions. Salt starvation, before referred to, finally results in death, and of this fact the author points to many striking experiments. The different tissues appear to exercise a distinctive action upon the various salts taken into the body; thus, the muscles contain an excess of potassium, and in fever urine the amount of this element is three or four times greater than in healthy urine. Herbaceous food decidedly increases the quantity of potassium in the urine. The carbonates of the alkalis perform an important part; hence the value of fresh vegetable foods. The presence of hydrochloric acid in the gastric juice appears to be due to the double decomposition of acid sodium carbonate and sodium chloride; hence the necessity for the presence of both these salts for normal digestive functions. Calcium salts play an important part in the formation of the bones of young animals. Iron is undoubtedly a valuable food, and, contrary to popular opinion, exists more largely in the muscular tissues than in the blood.—C. C. H.

Preservation of Milk, Meat, and Eggs. L. Liebermann. *Maly's Jahresh. f. Thierchemie*, 1885.

EXPERIMENTS are described on the use, as antiseptics, of various preparations of boric acid, such as boroglyceride, a mixture of borax and boric acid, and of the latter with salicylic acid. Milk was preserved for seven, and meat for five days, by boroglyceride. A mixture of borax and boric acid preserved meat for seven days, eggs for eighteen days, and milk (in closed vessels) for from ten to fourteen days. An injection of a mixture of salicylic and boric acid into the veins of a living animal served to prevent the carcase from decay, provided that it was cleaned immediately after death.—V. H. V.

On Normal and Pathological Cow's Milk, its Analysis: Dilution with Water, Albumen. H. Lajoux. *J. Pharm. Chim.* 14, 216.

IN the municipal laboratory of Paris it is assumed that the extractive matter in milk amounts to 130grms. per litre, but the author finds, from numerous analyses of the milk from Rheims, that the average is 126grms. He states that the amount depends on the food and the length of time the cows are kept in the stalls, and not on differences of breed. The author believes that an estimation of total albumenoids affords the best criterion of purity. The method of analysis adopted by him is as follows:—(1) determination of specific gravity; (2) estimation of total solids at 95°; (3) determination of salts; (4) estimation of milk-sugar by polarimeter after treatment with lead acetate; (5) determination of butter—10grms. of milk are evaporated in a small basin with 5grms. of fine sand; the residue is extracted with ether, and the fat dried at 95°; (6) determination of albumenoids. The author considers the ordinary methods unreliable, and takes the amount of albumen to be the difference between the total extractive matter and its components other than albumen. The mean of numerous analyses gives 33.02grms. per litre as the normal amount of total albumenoids; if the cow is healthy it is never less than 30grms. A milk with less than 30grms. should be rejected, while, if the amount is greater than 40grms., the health of the cow is doubtful.—S. Y.

Certain Improvements in the Production of Evaporated Milk. A. H. Reed, London. From R. Ellin, Yonkers, N.Y. Eng. Pat. 10,518, August 17, 1886. 8d.

THE milk is first mixed with about 10 per cent. by weight of cane sugar, and one or two drops of glycerine to each gallon. It is then evaporated to dryness in a pan, heated by a water or air-bath to a temperature of from 90–130° F., and under a vacuum of 26 to 29 inches of mercury. The interior of the pan is provided with cutting blades, and also a series of scrapers, set on a shaft and revolving in opposite directions; these thoroughly agitate the condensed milk, and keep the sides and surfaces of the pan free from solid accumulations. The product is a dry granular powder.—C. C. H.

Improvements in the Manufacture of Vinegar. G. G. Picking, W. H. Hopkins, John Dore, and James Dore, Bromley, London. Eng. Pat. 12,035, Oct. 9, 1885. 6d.

WHITE VINEGAR is obtained by subjecting malt or other vinegar to a process of distillation in vacuo, in an apparatus consisting of a still, a condenser, and a receiving vessel. The vacuum is maintained in every part of the apparatus by an ordinary vacuum pump, a water column, or a steam jet.—C. C. H.

Improvements in and Apparatus for the Treatment of Rancid Butter and other Materials for Purifying, Flavouring, and Mixing the same. J. Y. Johnson, London. From C. Marchand, New York. Eng. Pat. 4062, March 23, 1886. 8d.

Two vessels of any shape are arranged side by side, communicating with each other by small holes at the bottom ends. Each is fitted with a piston, to which motion is communicated by cranks, one of which is 180

degrees in advance of the other. The butter, together with the purifying liquid, is placed in one vessel, and by the rotation of the driving cranks transferred from one to the other through the small holes before mentioned. The butter is thus brought into intimate contact in fine threads with the purifying liquid, and in such a manner that "the grain" is not destroyed. It is then washed with water in the same apparatus, finally with butter-milk. The temperature must be kept normal at about 57–62° F.—C. C. H.

Improved Treatment of Alimentary Substances for their Preservation, and Apparatus for that purpose. H. Pischon, Berlin. Eng. Pat. 14,697, Nov. 30, 1885. 8d.

For the preservation of flour, or small grains of rye, wheat or peas, it must be rendered free from water, and compressed so as to exclude air. The apparatus shown is for effecting this object. The substance is passed from the hopper *a* in measured quantities by the valve *d*, on to steam-heated revolving trays *e*, enclosed in a cylinder *b*, from which the air is exhausted through a passage *c*. Agitators *f*, *f*¹ distribute the flour, etc., in

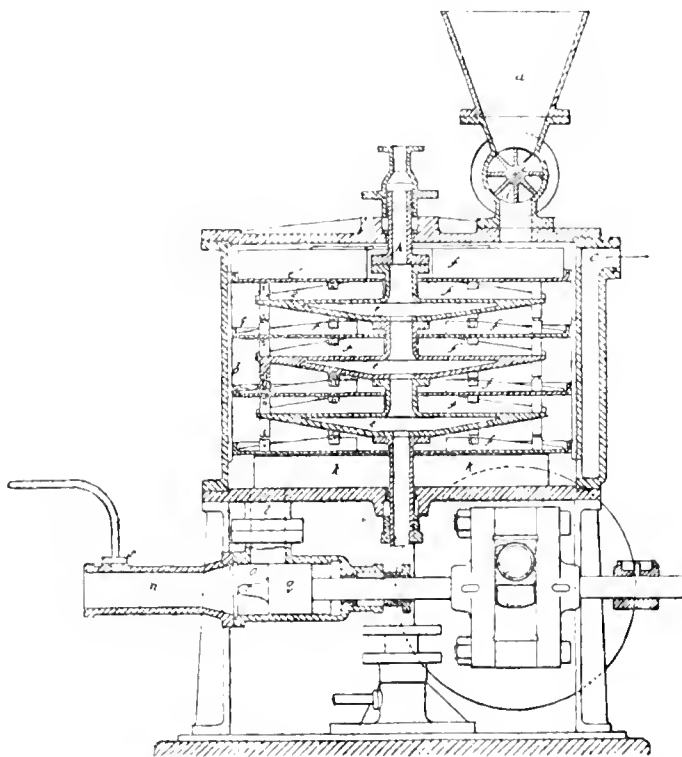
through the kitchen chimney. If this is not practicable, a special tube of galvanised iron is carried high up through the interior of the house and should be warmed by a gas flame or otherwise. It is a mistake to allow the closet to be exposed to the air of the house on the supposition that the drainage gases can be removed, as the pressure of the external atmosphere is for the most part of the year greater than that on the upper part of the soil-pipe. The drainage gases would be thus forced into the house.—V. H. V.

(C) DISINFECTANTS.

Process and Means for Disinfecting, Deodorising, and Purifying Sewage and other Foul Waters or Matters. J. Hanson, Wakefield. Eng. Pat. 12,261, Oct. 14, 1885. 4d.

BLACK-ASH or alkali waste, spent gas-lime, or any such substances as contain sulphites or hyposulphites, are added to the sewage in conjunction with sulphuric or hydrochloric acid, setting free sulphurous acid.

—C. C. H.



thin layers on the fixed and revolving trays *e*¹, *e*, and pass it from one to the other. Finally it is delivered into the small cylinder *o*, where it is pressed through a restricted orifice *n* by a reciprocating piston *q*, pure nitrogen or carbonic anhydride being simultaneously supplied through the pipe *s* to effectually displace any air.—C. C. H.

(D) SANITARY CHEMISTRY.

The Water-closet System in Dwellings. Recknagel. Chem. Zeit. 10, 1259.

IN water closets, the drainage gases can be removed by a stream of water flowing continuously through the soil-pipe with a certain velocity. In the dry systems, the flap must be closed air tight, and the soil-pipe connection must also be air-tight; a second pipe must be led from under the seat to the roof of the house, preferably

Improvements in the Preparation of Agents to be used in the Treatment of Sewage, etc., and Improvements in the Treatment of such Matters. J. W. Slater and The Native Guano Company, Limited, London. Eng. Pat. 13,750, Nov. 11, 1885. 6d.

THE sewage, if acid, must first be neutralised and then treated with clay, peat, or carbonaceous matter, sometimes previously mixed with sulphate or chloride of manganese, or copper. A mixture of solutions of copper and iron slag in hydrochloric acid, or a solution of chloride of aluminium, is then added.—C. C. H.

Improvements in the Treatment of Sewage and other Liquid or Semi-liquid Putrescent or Putrescible Matters. W. C. Sillar and The Native Guano Company, Limited, London. Eng. Pat. 13,749, Nov. 11, 1885. 6d.

SEWAGE, or similar matter, is treated with solutions of salts of the heavy metals—*e.g.*, aluminium, iron

or copper, or solutions of salts of "true earths" (excluding the so-called "alkaline earths"), heated to a temperature higher than the sewage itself. Clay, carbon, or carbonaceous materials suspended in water, heated to a temperature higher than the sewage, may also be used in conjunction with the solutions of the salts mentioned above.—C. C. H.

The Complete Purification of Sewage from Organic Matter. J. H. Kidd, Wrexham. Eng. Pat. 16,060, Dec. 31, 1885. 4d.

A SOLUTION of protosulphate of iron (20 parts) is treated with 4 parts of caustic lime, producing "a mixture of suboxide and hydrated sesquioxide of iron," and this, together with 1 part of refuse soap, is added to the sewage after the latter has been allowed to subside. Bog-iron ore, without the addition of lime, may also be employed. Where the effluent from the above treatment cannot be passed over land, it may further be purified by the addition of potassium permanganate, potassium or sodium bichromate, or chromic acid, with a small quantity of sulphuric acid.—C. C. H.

Improvements in the Preparation of Materials suitable for use in the Treatment of Sewage and for other Purposes. F. Caudz, London. Eng. Pat. 1792, Feb. 6, 1886. 4d.

CAUSTIC LIME, at a temperature of 150–200° F., is thoroughly incorporated with from 5 to 12 per cent. of tar. The mixture is carbonised out of contact with air in any ordinary suitable apparatus. The carbonaceous mixture so produced is added to the sewage in such cases where it may be requisite to render it alkaline, prior to the addition of other precipitants.—C. C. H.

XVIII.—ELECTRO-CHEMISTRY.

Improvements in the Manufacture of Carbon Filaments for Electric Lighting. T. V. Hughes, Wales; and C. R. Chambers, London. Eng. Pat. 11,876, Oct. 6, 1885. 8d.

INTO a crucible, kept at a bright red heat, a stream of gas containing certain proportions of marsh gas, hydrogen, and ethylene, is introduced by a perforated nozzle. After a while, fine hair-like filaments grow from the nozzle to the walls of the crucible. These filaments are not only very dense and homogeneous, but are very strong and flexible.—E. T.

Improvements in the Composition and Decomposition of Compound or Complex Bodies. J. G. Lorrain, London. Eng. Pat. 12,074, Oct. 10, 1885. 1s. 1d.

IN the vessels in which chemical action is being carried on, electrical gravity contacts are placed, automatically operated by the density of the contents. These contacts control electromotors, which bring about the supply of the various ingredients to the vessel, or their removal from it.—E. T.

Improvements in the Manufacture of Incandescent Lamps. W. Maxwell, London, and T. V. Hughes, Wales. Eng. Pat. 13,485, Nov. 7, 1885. 4d.

IN order to obtain a high vacuum without danger to the lamps, or discomfort to the operator, the former are enclosed during exhaustion in a vessel kept hot by a current of heated gases.—E. T.

Improvement in Thermo-electric Batteries. A. Burjorji, Gandevi, India. Eng. Pat. 14,037, Nov. 7, 1885. 8d.

METALS, when suddenly cooled, are changed mechanically, and therefore acquire different thermo-electric qualities at different points. To obviate this, pressure is put on the couple, by enclosing it in a strong casing with

a metal of a different co-efficient of expansion. This pressure is intended to effect a more homogeneous distribution of the particles of the couple.—E. T.

Improvements in Secondary Batteries or Electrical Accumulators. Jas. Y. Johnson. From S. Farbaky and Dr. S. Schenek, Hungary. Eng. Pat. 13,697, Nov. 10, 1885. 8d.

THE plates consist of lead grids, the interstices of which are packed with a special material; for negative plates this material consists of 95 parts by weight pulverised litharge and 5 parts granulated pumice stone, the grains being from 1 to 1½ mm. in diameter. Enough sulphuric acid is added to form a stiff paste; the mass is spread over the lead grids and "stroked with a brass bar until there is a visible sweat on the surface;" the material projecting above the lead frame being pared off with a long knife. The other side of the plate is treated in the same manner. The packing for positive plates consists of 95 parts by weight of litharge, 95 parts minium and 10 parts powdered coke. The coke and pumice stone give porosity, and thus facilitate the entry and escape of the electrolyte. The plates, when dry, are dipped into a bath of sulphuric acid diluted with 75 per cent. of water, rapidly removed and left to drain; after about 24 hours they are again dipped in the bath and left there for 12 hours. This treatment helps to maintain the packing in position. The plates are packed in airtight cells, the connecting rods projecting through the cover.—B. T.

Improvements in certain Elements for Electrical Batteries. J. T. Armstrong, London. Eng. Pat. 14,333, Nov. 24, 1885. 6d.

INSTEAD of using plates of similar metal, in both compartments of a battery, another metal, such as iron, is substituted for one of the plates in order to obtain equal or greater electrical power at a reduced cost. Laminated plates or bars of dissimilar metals are made use of. To make the working of a battery more regular and continuous, a small percentage of silver, lead, tin or other alloy is added to the zinc from which plates are to be formed.—B. T.

An Improvement or Improvements in Utilising Waste Products obtained in Galvanising Iron. R. Heathfield, Birmingham. Eng. Pat. 14,411, Nov. 24, 1885. 6d.

THE seum which is formed on the surface of the bath of melted zinc consists of chloride of zinc, ammonium chloride, oxide of zinc and some metallic zinc. The object of this process is to utilise the zinc contained in this seum. By treating with water, the chlorides of ammonium and zinc are dissolved out, leaving a residue consisting of oxide of zinc and metallic zinc, from which residue the zinc can be obtained in any ordinary way. The chlorides of ammonium and zinc are put into a bath, into which dip an anode of zinc or carbon and a cathode of the metal to be coated; a current of electricity is sent through the bath and pure zinc is deposited at the cathode.—B. T.

Improvements in the Production of Metallic Zinc from Products resulting from the Galvanisation of Iron, and the Recovery of Ammonia or Ammoniacal Compounds from the said Products. W. F. Richards, Swansea. Eng. Pat. 13,982, Nov. 16, 1885. 4d.

GALVANISERS' DROSS, consisting largely of zinc and ammonium chlorides, is dissolved in water with the minimum quantity of hydrochloric acid, evaporated to 25° Baumé and electrolysed till free from zinc, the residual liquors being treated for ammonia.—W. G. M.

An Improved Galvanic Battery. A. Dun and F. Hasslach, Frankfort-on-the-Main. Eng. Pat. 14,612, Nov. 27, 1885. 6d.

THIS cell consists of zinc and carbon (or other suitable substance), as electrodes, in a solution of a manganate

or permanganate mixed with a caustic alkali. It is claimed to have a high electromotive force and low resistance, to be very constant, being without local action; and its products are of marketable value. Its use as an accumulator is also claimed.—E. T.

Improvements in the Method of Supplying Liquids and Mixtures to Electrical Batteries. J. T. Armstrong, London. Eng. Pat. 398, Jan. 9, 1886. 8d.

AFTER a battery has been working for some time the electrodes usually become coated with a deposit which is deleterious to the working of the battery. In this method the exciting fluid is periodically withdrawn and a liquid passed in, which has the effect of reinvigorating the battery by removing the deposit. Two cisterns are provided, connected with the battery by flexible tubes, one cistern containing the exciting and the other the cleansing liquid; the connection between either cistern and the battery can be opened or closed by suitable plugs. These cisterns, which are fitted to a suitable framework, are capable of independent motion to positions above or below the battery, so that the fluid from either of them can be passed into the battery or that in the battery be withdrawn into either of the cisterns.—B. T.

Improvements relating to the Electro-deposition of Aluminium. W. R. Lake. From Count R. de Montgela, Philadelphia, U.S.A. Eng. Pat. 10,607, August 18, 1886. 4d.

ALUMINA is treated with hydrochloric acid and aluminium chloride obtained; this liquid is placed in a bath, into which dip a suitable anode and a cathode of brass or copper. On the passage of a current of electricity through the bath, the iron present in the liquid is first deposited, and as soon as this deposition ceases, which is apparent by the change of colour in the deposit, the liquid is decanted into a similar bath, and to it is added about fifty per cent. by weight of the oxide of either lead, tin or zinc. On sending a current of electricity through this bath, aluminium, together with the metal of the added oxide, is deposited at the cathode.—B. T.

Improvements in the Production of Aluminium and Aluminium Bronze. R. Grätzel, Bremen. Eng. Pat. 14,325, Nov. 23, 1885. 6d.

SEE p. 608.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Reactions of Brucine. H. Beckurts. Chem. Zeit. 10, 81.

BRUCINE dissolves in chlorine water with a red colouration due to the formation of a dichloro-derivative, obtained on evaporation as a red-brown amorphous powder. The colouration disappears on addition of excess of the chlorine water, but is restored when this excess is driven off. Bromine water forms when added to solutions of brucine salts a yellow amorphous precipitate of the tribromide, decomposed by warming with water into brucine hydrobromide and dibromobrucine.

The strychnine reaction—namely, the blue-violet colouration, with sulphuric acid and an oxidising agent—does not occur with brucine, as oxidation supervenes.

—V. H. V.

Pseudomorphine. O. Hesse. Annalen, 235, 229.

POLSTORFF has deduced for pseudomorphine or oxydimorphine the formula $C_{24}H_{36}N_2O_6$ from determinations of the quantity of it—namely, eighty per cent., formed by the oxidation of morphine by potassium ferri-cyanide in alkaline solutions. He did not, however, examine as to how far the specimens used were free from pseudomorphine, or as to the possibility of the conversion of morphine into pseudomorphine by exposure of the alkaline solution to the air. Avoiding these sources of

error the author has repeated the experiment, and found the yield of pseudomorphine to be 88.4 per cent. The reaction is as follows:— $2C_{17}H_{19}NO_3 + O = C_{17}H_{19}NO_3 + C_{17}H_{18}NO_3 + H_2O$.—V. H. V.

Saccharine as an Antiseptic. V. Adacco and H. Mosso. Gaz. Chim. Turin, 1886.

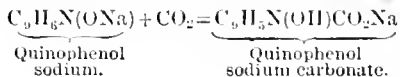
EXPERIMENTS are quoted to show that saccharine (benzoylsulphonicimide) acts as an antiseptic in fermentations of sugar, wine and milk. Peptonisation and diastasis are retarded. It possesses medicinal value in cases of *diabetes mellitus*, and also of abnormal processes in the stomach. It is also useful for certain disinfecting processes in the intestines.—V. H. V.

Improvements in Acid Bases for Aerated and other Beverages and Tonics. A. G. Brookes. Eng. Pat. 14,002, Nov. 7, 1885.

THIS invention consists in mixing lactic acid with 2 per cent. of lactate of lime and traces of gluten, gum, colouring matter and sulphate of lime with water, sugar, or syrups, for use as above.—T.

A Process for the Manufacture of Oxyquinoline Carbonates. J. Y. Johnson, Middlesex. From Dr. F. von Heyden, Nachfolger, Radebeul, near Dresden. Eng. Pat. 10,280, August 11, 1886.

THIS invention has for its object the production of oxyquinoline carbonates by treating alkaline oxyquinolines and earthy alkalis at a high temperature with carbonic acid under pressure—viz., 130° to 150° C. The conversion takes place quantitatively according to the equation—



—T.

XXII.—GENERAL ANALYTICAL CHEMISTRY.*

On the Testing of Brown or Pale Brown Mineral Oils. H. Hager. Pharm. C. H. N.F. 7, 397.

(1.) A MIXTURE of 2cc. of the mineral oil with 2cc. of petroleum spirit and 4cc. of water is vigorously shaken in a test glass at the ordinary temperature, and allowed to stand. If the oil is pure or is adulterated only with resin oils, an immediate separation occurs, and after a few hours two approximately equal layers are formed. The surface of contact of the layers may be turbid, but should not be more than 5mm. thick. If fatty oils are present, three layers are formed, the relative bulk of which changes after three or four hours. The lowest aqueous layer is very turbid, the uppermost layer oily and somewhat translucent, and the intermediate layer emulsive or milky. If the uppermost layer is also milky or emulsive, adulterations of a soapy nature are present.

(2.) In order to ascertain whether resin oils are present a mixture of 2cc. of the mineral oil, with 2cc. of petroleum spirit, 4cc. of water, and 1cc. of 10 per cent. ammonia, is vigorously shaken. If, after an hour or two, two equal layers are formed, of which the upper oily one is translucent or clear, and the lower aqueous layer has no milky appearance, the oil is pure. But if either two or three layers are formed, of which, after from five to ten hours, one or more possess an emulsive or milky appearance, then resin oils are present.

(3.) The fatty oils are saponified by heating with a caustic alkali and 60 per cent. alcohol. The soap is dissolved in 60 per cent. alcohol, the solution evaporated, decomposed with dilute sulphuric or hydrochloric acid, and the fatty acid collected on a moistened filter.

(4.) The separation of resin oils is effected by shaking with 89 to 90 per cent. alcohol at 25 to 30° . Twenty

* The woodcut on page 550 of the October number of this Journal was unfortunately placed upside down in arranging the type in pages.

parts of the luke-warm alcohol dissolve 1 part of resin oil. After evaporation of the alcohol the extracted resin oil has a specific gravity of 0.95 to 0.98, or is sometimes even heavier. Its composition may be ascertained by the usual methods.—S. Y.

Detection of Arsenic in Hydrochloric Acid and Metallic Copper (Reinsch's Test for Arsenic). H. Hager. Pharm. C. H. 1886, 7, 439.

METALLIC COPPER, used for the removal of arsenic from hydrochloric acid, must present a perfectly clean metallic surface; the presence therein of arsenic is not of importance, as the arsenide of copper is not attacked by the hydrochloric acid. In order to recognise the presence of arsenic in copper, a few drops of ammonia are poured upon the metal, and the action allowed to proceed for half-an-hour; the surface is then washed with water, and the stain formed is then dried with linen. Acetic acid is then poured upon the stain, and allowed to remain for 10 minutes; the surface is then washed, and the stain rubbed with linen. The presence of arsenic is revealed by the appearance of a grey stain, easily recognised under a lens.—V. H. V.

Detection of Free Sulphuric Acid in Aluminium Sulphate. H. Hager. Pharm. C. H. 1886, 7, 440.

IN order to detect the presence of free sulphuric acid in aluminium sulphate, the finely-powdered salt (about 0.25grm.) is added to a previously-warmed mixture of 2 drops of gurgun balsam and 3cc. of acetic acid; on warming, a bright blue, with traces of acid, or a dark blue colouration in the case of larger quantities, results. The presence of free aluminium hydroxide is detected by adding the crystalline salt to two parts of water; a milky solution is formed.—V. H. V.

Analysis of Peptone. G. Bodländer. Chem. Zeit. 10, 216—217.

THE author, after alluding to the criticism of König, describes his method for the estimation of peptones as follows:—5—10grms. of the substance are dissolved in 300cc. water and 5cc. of acetic acid added. The precipitate formed is collected on a weighed filter-paper, washed with hot water, dried, and weighed. This weight, less that of the ash obtained on incineration, gives the quantity of insoluble albumen. The filtrate and wash-water are collected and divided into two equal portions, of which one is saturated with sodium sulphate, which precipitates the soluble albumen or propeptone. The precipitate is collected on a weighed filter, washed with a saturated solution of sodium sulphate, dried, and weighed. The weight of the precipitate, less that of the ash, gives the proportion of the soluble albumen. The other half-portion is treated similarly with ammonium sulphate, whereby the proportion of mesopeptone is obtained.—V. H. V.

General Applicability of Kjeldahl's Method for Estimation of Nitrogen. C. Arnold. Arch. Pharm. 24, 785.

KJELDAHL'S method for estimating nitrogen is applicable to the case of substances containing nitrogen as cyanogen, or an oxygenated grouping, provided that the substance before treatment with sulphuric acid be boiled in the former case with sugar, and in the latter with some substance such as benzoic acid, which will combine with the nitric acid set free by the sulphuric acid. Experiments proved that in presence of the above-mentioned substances, or of mercury or copper sulphates, this process is applicable for all kinds of nitrogen compounds. Further, in the case of alkaloids, a preliminary oxidation by potassium permanganate is not necessary.—V. H. V.

Determination of Nitric Acid as Ammonia. E. Reichardt. Arch. Pharm. 24, 798.

IN the determination of nitric acid in the form of ammonia by reduction with zinc and iron in presence of

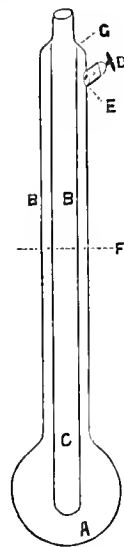
alkali, a difficulty is experienced in the presence in the alkali of nitrates, added by the manufacturer, to produce a white product. This may be obviated by fusion of the alkali and addition of a small quantity of zinc dust until a test portion removed no longer gives the brucine reaction of the nitrates.—V. H. V.

Determination of Carbon in Organic Substances in Aqueous Solution. Zeits. Rübenzucker, Ind. 36, 754.

THE values obtained for the carbon in organic substances when oxidised by chromic acid solution are frequently affected by the presence of chlorine compounds, evolving under these conditions chlorine, which is absorbed by the potash apparatus. This may be avoided by interposing in the calcium chloride tube of Rose's absorption apparatus a layer of dried and finely-powdered metallic antimony, and by conducting the analysis sufficiently slowly. Experiments with acetic, stearic, and phthalic acids gave satisfactory results.—V. H. V.

A New Apparatus for Determining Melting Points. C. F. Roth. Ber. 19, 1970—1972.

THE apparatus consists of a small, round-bottomed flask A, with a long neck B. The flask is 65mm. diam., the neck 200mm. long and 28mm. wide. Into the neck a glass tube C is sealed, closed at its lower end, which is 17mm. from the bottom of the round-bottom flask.



This tube has a diameter of 15mm. Near the top of the neck, a side tube D, 11mm. wide, is fused on, which has a small perforation at the side. A hollow stopper E fits into this with a similar perforation. Before use the flask is filled to the mark F with conc. H_2SO_4 . The hollow stopper is turned until the two side openings coincide. The sulphuric acid on heating rises in the outer vessel and converts the inner vessel in which the thermometer and the substance is placed into an air-bath of nearly constant temperature. From a series of experiments the author finds that with this apparatus no correction for difference of temperature of the mercury column is required.—J. B. C.

Dehydromorphine (Oxydymorphine). J. Donath. J. Prakt. Chem. 1886, 559—560.

AFTER giving a short history of dehydromorphine and its artificial preparation from morphine, the author adds his own observations on the properties of these two bodies. They may be distinguished by the following reaction:—Dehydromorphine is mixed with 8 drops of

H_2SO_4 (2 vol. conc. H_2SO_4 and 1 vol. H_2O) and gently warmed until acid vapours are evolved. The liquid assumes a bluish-green colour. Diluted with water the solution changes to rose-red, which, on the addition of an oxidising agent (1–2 drops conc. HNO_3 or 1 drop of a solution of 1 part NaNO_2 and 20 parts H_2O or 1 drop of NaClO solution), changes to deep violet. Morphine, on the other hand, treated in the same way, gives a red, on further heating a dirty brown, on dilution a reddish colour, and on oxidation a beautiful cherry red. The following reactions are common to both substances:— FeCl_3 gives a brownish-green; conc. HNO_3 a blood-red, Fröhde's reagent (conc. H_2SO_4 containing molybdic acid) a violet colouration. They also reduce iodic acid when other acids are absent.

The yield of dehydromorphine, according to Polstorff's method of preparation, is 63 per cent. Like morphine, it dissolves in hot amyl alcohol. The hydrochloride is soluble in water and alcohol, though less readily in hot alcohol than morphine. A 1-per-cent. aqueous solution of the hydrochloride dissociates on standing. The specific rotatory power of the anhydrous hydrochloride is -103.13° .—J. B. C.

Two Reactions for Morphine. J. Donath. J. Prakt. Chem. 1886, 563–565.

A SMALL QUANTITY (1mgm.) of finely-powdered morphine is rubbed with 8 drops conc. H_2SO_4 in a porcelain basin, a little potassium arsenate added, and the whole well mixed. On heating the mixture until acid vapours begin to escape, a violet-blue colour is formed which, on further heating, changes to dark-brownish red. On carefully diluting with water a reddish colouration is produced, which, on further dilution, changes to green. If chloroform is shaken with this liquid, the former is coloured violet. Ether acts in the same way. Dehydromorphine mixed with sulphuric acid and potassium arsenate produces a dirty-green colour, on heating a brown, and on dilution with water, a deep green. This latter solution, however, does not colour chloroform. Another reaction of morphine is as follows:—A small quantity of morphine is rubbed with 8 drops of conc. H_2SO_4 . On the addition of a drop of a solution of 1 part KClO_4 in 50 parts conc. H_2SO_4 , a beautiful grass-green colouration is formed, and at the edge of the liquid a faint rose red. Dehydromorphine under the same conditions gives a brownish-green colour.—J. B. C.

On the Diphenylamine Reaction in Milk Analysis. J. Szilasi. Rep. Anal. Chem. 6, 436.

THE author's method is a more rapid one than that of J. Herz. (*Chem. Zeit. Rep.* 10, 172). A little milk is dropped by means of a glass rod into about 1cc. of a solution of diphenylamine; colouration occurs at once or after a time, according to the quality and quantity of the water added to the milk. An addition of 25 per cent. of Buda Pesth water containing 10mgm. N_2O_5 to the litre, is not recognisable by this method, but 5 per cent. of a bad water gives a distinct reaction.—S. Y.

Method of Distinguishing between Genuine and Artificial Butter. C. Virchow. Rep. Anal. Chem. 6, 459.

WHEN butter is in an advanced state of decomposition the limits for the fatty acids, obtained by Meissl's method, and hitherto accepted as correct, are too high. Meissl has taken 25cc., Sendtner 24–25cc., Pirbaum 24–9cc., and the Society of Bavarian Chemists 26cc., of deci-normal caustic soda solution as the minimum. The characteristics of old artificial butter are: Tallow-like or hard consistency, slight smell and taste, the fat when melted remains turbid either permanently or for a long time, and is only imperfectly saponifiable, yielding a very fluid, milky soap; a solution in ether remains clear under conditions in which a similar solution of the fat of genuine butter would give a crystalline precipitate (*stearin, palmitin*). The rancidity is determined by titrating with deci-normal caustic soda and

phenolphthalein, a solution of 5grms. of the melted fat dissolved in 10cc. ether together with 20cc. of absolute alcohol. Samples which have a strong smell of butter, and which do not possess the characteristic properties of artificial butter, if very rancid contain comparatively little free fatty acid. Great rancidity is a sign of considerable decomposition of the glycerides of the so-called volatile fatty acids, and the quantity of butyric acid is lessened by volatilisation or further decomposition of it. Hence, very marked rancidity is a safe indication of old genuine as opposed to old artificial butter. No definite relation between the rancidity and amount of fatty acid could be found. In Switzerland the sale of rancid butter containing much mould and bacteria, is rightly forbidden as "spoilt," but it cannot be condemned as "artificial butter." If greatly decomposed, the rancidity of the sample should invariably be determined.—E. E. B.

Separation of Nickel and Cobalt. Pietro Gucci. Gazz. Chim. 1886, 207.

THE qualitative separation is effected by fusing the sulphides, precipitated by ammonium sulphide and insoluble in hydrochloric acid, with potassium nitrate in a porcelain crucible, boiling the fused mass with water-washing the oxides and treating them on the water, bath with dilute nitric acid (sp. gr. 1.2). The oxide of nickel is rapidly and completely dissolved, and the cobalt oxide left behind.—S. Y.

Determination of Phenol in Crude Carboic Acid. J. Tóth. Zeits. Anal. Chem. 25, 160–164.

THE method employed is a modification of Koppeschaar's (*Zeits. Anal. Chem.* 15, 233), which depends on the formation of tribromophenol, and is as follows: 20cc. crude carboic acid are placed in a beaker and treated with 20cc. concentrated potassium hydrate of sp. gr. 1.25–1.30, well mixed, and allowed to remain. At the end of about half-an-hour it is diluted with water to 250cc. This causes the tarry matters to separate out on the top of the liquid, and they can be easily separated by filtration. The residue is washed with luke-warm water, until the washings have no alkaline reaction. The filtrate and washings are very slightly acidified with hydrochloric acid, and diluted to three litres. The strong dilution is necessary, as the solution for titration must not contain more than 0.1grm. phenol in 25cc. 50cc. of this solution are then decomposed with 150cc. bromine solution (2.04grms. sodium bromate and 6.959grms. sodium bromide in one litre) and 5cc. strong hydrochloric acid. At the end of twenty minutes 10cc. iodine solution is added (125grms. in one litre), and after standing five minutes a little starch solution is added, and the excess of iodine titrated with sodium thiosulphate (9.763grms. in one litre = 5grms. iodine).—G. H. M.

Detection of Salicylic Acid in Beer and Wine. Röse. Archiv für Hygiene, 1886, 127.

IF beer or wine contains only a small quantity of salicylic acid, other substances are removed on shaking with ether, which hide the reaction of the acid with ferric chloride. This error may be diminished by shaking 100cc. beer, which has been acidified by the addition of 5cc. dilute sulphuric acid, in a separating funnel, holding 200cc. with a mixture of equal parts of ether and petroleum-ether. The aqueous layer is drawn off and the ethereal solution poured from the neck of the funnel through a filter into a small flask. The ether and the greater portion of the petroleum-ether is then distilled off, and the hot residue thoroughly shaken with 3–4cc. water. A few drops of a dilute solution of ferric chloride is then added, with gentle shaking, and the liquid filtered through a filter moistened with water, which only allows the aqueous solution to pass through. On addition of the ferric chloride the petroleum-ether is coloured deep yellow, owing to the formation of an iron compound with the resin of the hop. If salicylic acid is absent the

filtrate is almost completely colourless with a very slight tinge of yellow, showing that no trace of tannic acid is taken up. If, however, only a trace of salicylic acid is present, the filtrate is at once coloured the well-known violet. It is possible in this way to detect 0.0001grm. of acid in one litre of beer.

In examining a wine the mixture of ether and petroleum-ether takes up a small amount of tannic acid from the wine. The presence of salicylic acid can then only be detected, provided an extremely small trace of tannic acid is present. It is necessary, if the aqueous solution after addition of ferric chloride shows the tannic acid reaction, to again acidify with sulphurous acid, dilute with water to 50cc., and once more shake with an equal volume of ether and petroleum-ether. If salicylic acid is present the characteristic colour reaction is obtained by distilling off the ether mixture from the second agitation, and adding ferric chloride to the aqueous solution of the residue as before. The tannic acid remains entirely in the aqueous layer in the separator. With red wines containing a quantity of tannic acid 0.0002grm. salicylic acid per litre wine can still be detected.—G. H. M.

On some Simple Methods of Distinguishing between Silver, Nickel, and Tin when deposited in Thin Layers on Metallic Objects. L. Loviton. *J. Pharm. Chim.* **14**, 227.

THE detection of electro-deposited metals by the ordinary methods is frequently difficult on account of the very small quantity present, and the occasional presence of the deposited metal as a component of the alloy on which the deposit is formed. The following methods are recommended by the author:—

I. A small piece of the substance is held in the oxidising flame of a Bunsen burner and the changes of colour of the surface observed.

(1.) *Nickel*: (a), Greyish-yellow colour; (b), violet reflection; (c), blue colour with strong black reflection (characteristic); (d), uniform grey colour with green reflection.

(2.) *Tin*: (a), Faint greyish-yellow colour; (b), light violet-blue reflection, very transitory; (c), grey colour, spotted surface; (d), wrinkled surface with yellow spots.

(3.) *Silver*: (a), Nothing visible to naked eye; (b), small yellow spots; (c), more rapid change to uniform grey with white spots; wrinkled greyish-yellow surface.

II. The object is placed a few minutes in a boiling concentrated solution of common salt.

(1.) *Nickel*: Reddish-blue colour after ten minutes.

(2.) *Tin*: Almost imperceptible, faint grey colouration.

(3.) *Silver*: Unaltered.

Similar results are obtained with hydrogen peroxide to which a little powdered manganese dioxide is added.

III. The object is placed in warm dilute ammonium sulphide.

(1.) *Silver*: The surface is blackened.

(2.) *Tin*: The deposit is dissolved.

(3.) *Nickel*: Unaltered.—S. Y.

New Books.

COMMERCIAL ORGANIC ANALYSIS: A Treatise on the Properties, Modes of Assaying, and Proximate Analytical Examination of the various Organic Chemicals and Products employed in the Arts, Manufactures, Medicine, etc.; with Concise Methods for the Detection and Determination of their Impurities, Adulterations, and Products of Decomposition. By ALFRED H. ALLEN, F.I.C., F.C.S., Public Analyst to the West Riding of Yorkshire, the Northern Division of Derbyshire, and the Boroughs of Sheffield, Chesterfield, Doncaster, Wakefield, etc. Second Edition, Revised and Enlarged. Vol. II.: Fixed Oils and Fats, Hydrocarbons, Phenols, etc. London: J. & A. Churchill, 11, New Burlington Street. 1886.

THE notice of the appearance of the Second Edition of Vol. I. of this valuable work will be found in this

Journal, vol. iv. p. 420. The present issue of the Second Edition of Vol. II. takes the form of an octavo volume, bound in cloth, containing Preface, Table of Contents, and 573 pages of subject matter, Tables of Errata for Vols. I. and II., and an Alphabetical Index. The work is illustrated by seventeen woodcuts. The following concise Abstract of the Contents of this volume will give a sufficiently clear idea of the extent of the ground covered, as well as of the mode of treatment adopted:

GENERAL CHARACTERS OF FIXED OILS AND FATS.—Extraction and Purification of Fixed Oils and Fats; Physical Properties of Fixed Oils and Fats; Constitution and Chemical Properties of Fatty Oils and Waxes; Classification of Fatty Oils, etc.; Examination of Fixed Oils for Foreign Matters; Identification of Fixed Oils; Special Characters and Modes of Examining Fatty Oils, etc.; Examination of Lubricating Oils; Higher Fatty Acids; Soaps; Glycerin; Cholesterin. **HYDROCARBONS.**—Tabular Arrangement of Hydrocarbons in Series; Destructive Distillation; Crude Oily Products of Dry Distillation; Tars; Crude Hydrocarbons of Mineral Origin; Bitumens; Petroleum and Shale Products; Terpenes and their Allies; Benzene and its Homologues; Naphthalene and its Derivatives; Anthracene and its Associates. **PHENOLS.**—Monohydric Phenols; Dihydric Phenols.

REPORT ON EXPERIMENTS MADE TO TEST THE GERMINATION AND GROWTH OF FARM SEEDS IN VARIOUS MIXTURES OF GARDEN SOIL AND BASIC CINDER. By J. M. H. MUNRO, D.Sc., F.C.S., College of Agriculture, Downton, Salisbury. Eight pages 8vo. Middlesborough: *Daily Exchange Office*, 1886.

This report is supplementary to a previous one on the Manurial Value of Basic Cinder, by the author and Professor Wrightson, and contains experiments which tend to show that the popular belief in an injurious influence exercised on vegetation by protoxide of iron in the soil, has no basis in fact. An abstract is given on p. 437.

A SYSTEMATIC HANDBOOK OF VOLUMETRIC ANALYSIS ON THE QUANTITATIVE ESTIMATION OF CHEMICAL SUBSTANCES BY MEASURE, APPLIED TO LIQUIDS, SOLIDS, AND GASES. Adapted to the Requirements of Pure Chemical Research, Pathological Chemistry, Metallurgy, Manufacturing Chemistry, Photography, etc., and for the Valuation of Substances used in Commerce, Agriculture, and the Arts. By FRANCIS SUTTON, F.C.S., F.I.C., Public Analyst for the County of Norfolk; Corresponding Member of the Austrian Apotheker Verein, Vienna; Consulting Chemist in the Norfolk Chamber of Agriculture; etc., etc. Fifth Edition. London: J. & A. Churchill, New Burlington Street. 1886.

OCTAVO VOLUME, bound in cloth, containing Preface, Tables of Contents of the Atomic Weights of the Elements, and of Abbreviations and Explanations, followed by 483 pages of subject matter and eight pages of Alphabetical Index. With the text are interspersed ninety wood engravings. The work is divided into seven parts. PART I. deals with General Principles, Instruments employed, Preparation of Normal Solutions in General and Direct and Indirect Processes of Analysis. PART II. is devoted to ALKALIMETRY: Indicators used; Titration of Alkaline Salts; Alkaline earths; Ammonia; ACIDIMETRY: Estimation of Combined Acids in Neutral Salts, etc. PART III.: Methods of Analysis, mainly based on Oxidation and Reduction. PART IV.: Analysis by

Precipitation; Precision in Colour Reactions; The Colorimeter. PART V.: Antimony, Arsenic, Barium, Bismuth etc.; Chlorine, Bromine, Chlorine Gas and Bleach, Ferro- and Ferrihydrides, Sugar, Phosphoric Acid and Phosphates, Nitrogen as Nitrates, etc. APPENDIX to PART V.: Boric Acid and Borates; Oils and Fats, Glycerin, Phenol, Carbon Disulphide, etc. PART VI.: Analysis of Urine and of Potable Waters and Sewage; Water Analysis without Gas Apparatus; Table of Calculations, etc. PART VII.: Volumetric Analysis of Gases; Gases estimated Directly and Indirectly; Analysis of Air and Carbon Dioxide; Improvements in Gas Apparatus; Simpler Methods of Gas Analysis, etc.

DIE GLYCOSIDE. Von Dr. O. JACOBSEN, Prof. der Chemie an der Universität, Rostock. 1887. Breslau: Verlag von Eduard Trewendt. London: H. Grevel & Co., 33, King Street, Covent Garden.

8vo VOLUME, bound in cloth, containing 174 pages of subject matter, including also an Alphabetical Index and 9½ pages of Bibliographic Notices, giving the entire literature of the subject. This work is reprinted from the *Encyklopädie der Naturwissenschaften*. It commences with a definition, followed by methods for the isolation and purification of the glucosides, next following methods for the artificial preparation of certain glucosides. A concise work of this description, with complete bibliographic notices, seems calculated to render great service to manufacturing chemists interested more especially in dyewood extracts, dyewoods, fine chemicals and the vegetablealoids.

TRADE, TARIFF AND CUSTOMS NOTICES.

(Abstracted from "Board of Trade" and other Journals.)

HOLLAND.—Various changes relating to the quality of foreign "bastard" sugar.

SWITZERLAND.—(Quintal = 220 lbs.). Sulphuret potassium and myrtle wine (colouring) to pay 10 francs per quintal. Phosphate soda, 1 franc per quintal. Bromide potassium-sodium, 2 francs per quintal. Pyrites, duty free. Vaseline, 1 franc 25 cents per quintal. Extract of berries, analogous to syrups (not thickened), with the addition of sugar or alcohol in casks, etc., 16 francs per quintal. Chloride of antimony, 1 franc per quintal. Disinfecting powder, loose or in packets which can be examined, 2 francs per quintal.

ITALY.—Persulphate iron, with traces nitric acid, 2 lire per quintal. Seeds of colchicum, free. Benzene in jars, 36 lire per quintal net weight. Carmine acid saccharated for use as a syrup, 55 lire per quintal. Tannic acid, containing 1 or 2 per cent. impurity, 10 lire per quintal. Todolo (a new antiseptic and disinfecting powder), containing lime and an essence, 10 lire per quintal. Oxide of lead, containing an aniline producing a brilliant red, rendering it similar to cinnabar, 75 lire per quintal. British coal imports are 92½ per cent. of the whole.

SERBIA.—Spirits over 38 per cent. (151°), 50 francs per 100 kilos. Petroleum, 20 francs per 100 kilos; there are deductions according to the kind of packages. Matches, 100 francs per 100 kilos.

SPAIN.—	Per Cwt.	
	£	s. d.
Alkaline carbonates and caustic alkalis	0 0 11	
Alum	0 0 5½	
Arsenic, white	0 1 0½	
Barytes	0 1 11½	
Chloride lime	0 0 6½	
Chromate potash	0 4 0½	
Hypo sulphites soda	0 4 0½	
Borax	0 4 0½	
Brimstone	0 0 11	
Green copperas	0 0 7½	
Other kinds	0 1 0½	
Epsom salts	0 0 2½	
Sal ammoniac	0 0 4½	
Nitrate potash	0 0 7½	
soda	0 0 11	
Salt	0 0 2½	
Perfumery essences	3 13 6	
Scented soap	3 13 6	
Paper, various kinds	2 11 9	
Starch	0 3 8½	
Indigo	0 1 1	
Matches, wood	0 7 7½	
" other kinds	0 13 6	

Artificial carbonate of lime, obtained by chemical process, and intended specially for industrial purposes, to pay 6cs. per 100 kilos, asbestos to pay 6cs. per 100 kilos, aurin to pay 3 pesetas (3½d.) per 100 kilos, scidletz powders to pay 1 peseta 85cs. per kilo., bismuth subnitrate to pay 10cs. per kilo., raw caramel, in barrels, same duty as foreign sugar, salicylate of soda (medicinal) 10cs. per kilo.

URUGUAY.—Machinery and plant intended for the manufacture of preserved meats will be exempt from all Customs dues; and, by decree of February 27 last, the proprietors of manufactories must apply for the necessary permit for such free admission to the Ministry of Finance.

TRADE STATISTICS FOR OCTOBER, 1886.

	1885.	1886.
Imports: Total value	£29,677,327	£29,054,399
Exports	18,674,198	18,221,823
Foreign and Colonial produce (partly estimated)	5,467,923	5,339,753
Imports: Chemicals, unenumerated	572,116	413,687
Dye stuffs: Tannins		
Exports: Chemicals and Medicinal Preparations	615,237	604,868

Below are the details affecting Drugs and Chemicals:—

Imports.

	Oct. 1884.	Oct. 1885.	Oct. 1886.
Chemical manufactures and products (unenumerated)	value £ 125,136	108,779	102,722
Alkali	cwt. 5,187	6,187	7,541
	value £ 5,722	5,014	4,578
Brimstone	cwt. 50,927	16,821	20,321
	value £ 12,880	4,559	5,907
Nitre (nitrate of soda)	cwt. 103,598	291,330	78,987
Nitre (nitrate of soda)	value £ 50,313	119,767	34,697
Nitre (nitrate of potash)	cwt. 27,615	31,759	23,038
Nitre nitrate of potash	value £ 24,812	26,099	20,060
Quicksilver	lb. 100,490	154,268	90,075
	value £ 7,505	11,382	8,060
Bark, Cinchona	cwt. 8,591	12,523	9,700
	value £ 69,751	74,251	47,390
Gum Arabic	cwt. 7,571	7,893	6,353
	value £ 22,122	29,166	29,161
Lac, seed, shell, stick, and dye	cwt. 10,438	9,768	11,124
Lac, seed, shell, stick, and dye	value £ 39,918	31,289	20,155
Dyes and tanning materials:—			
Bark (for tanners' or dyers' use)	cwt. 19,897	10,818	42,202
Bark (for tanners' or dyers' use)	value £ 8,079	2,765	18,506
Aniline dyes	" 29,411	22,371	21,649
Alizarin	" 15,201	25,807	19,778
Other coal-tar dyes	" 90	330	—
Cochineal	cwt. 1,087	1,128	1,381
	value £ 6,400	6,988	8,880
Catch and gambier	tons. 2,490	1,767	2,873
	value £ 63,503	36,708	65,899
Indigo	cwt. 1,618	1,367	817
	value £ 33,359	26,584	11,184
Madder, madder root, garancine, and munjeet	cwt. 2,077	3,031	1,333
Madder, madder root, garancine, and munjeet	value £ 2,660	5,184	1, 72
Valonia	tons. 967	925	1,994
	value £ 19,635	14,912	29,398
Oils:—			
Cocoa-nut	cwt. 27,272	8,680	26,117
	value £ 42,667	12,094	36,139
Olive	tons. 1,806	1,418	1,418
	value £ 73,020	57,049	54,014
Palm	cwt. 79,979	86,991	84,481
	value £ 128,140	112,291	81,761
Petroleum	gals. 6,276,171	8,230,606	5,427,095
	value £ 201,590	245,877	158,191
Seed, of all kinds	tons. 1,136	1,699	1,589
	value £ 38,326	43,491	28,525
Train, blubber, and sperm	tons. 2,025	1,971	2,016
Train, blubber, and sperm	value £ 55,983	46,700	32,585
Turpentine	cwt. 49,798	29,601	32,292
	value £ 59,945	36,930	50,122

Exports.

	Oct. 1884.	Oct. 1885.	Oct. 1886.
British and Irish produce:—			
Alkali	cwt. 658,979	590,544	601,753
value £	193,912	179,582	175,217
Bleaching materials	cwt. 171,512	107,012	157,574
value £	67,462	36,411	53,117
Drugs and medicinal preparations	86,231	80,988	70,484
Oil (seed)	gals. 1,219,800	1,538,300	1,646,000
value £	112,650	146,246	138,521
Soap	cwt. 40,072	27,047	43,692
value £	48,637	33,561	12,167
Painters' colours and materials (unenumerated)	value £ 119,083	106,479	107,921
Foreign and Colonial merchandise:—			
Bark, Cinchona	cwt. 10,844	13,492	11,177
value £	64,268	91,939	42,558
Chemicals (unenumerated)	11,631	19,397	10,007
Cochineal	cwt. 1,152	1,530	812
value £	6,617	9,402	5,294
Cutch and gambier	tons. 1,389	925	943
value £	36,660	20,326	23,618
Gum Arabic	cwt. 3,263	4,197	4,521
value £	11,183	15,189	18,441
Indigo	cwt. 3,807	4,092	4,032
value £	86,321	73,074	81,152
Lac, various kinds	cwt. 8,916	7,702	8,522
value £	32,421	25,023	25,557
Oils, cocoa-nut	cwt. 20,594	15,162	9,078
value £	33,327	22,416	12,111
olive	tons. 269	193	202
value £	12,578	9,619	8,147
palm	cwt. 73,678	32,125	28,486
value £	116,887	44,486	29,154
petroleum	gals. 39,591	52,366	91,328
value £	1,568	1,971	3,071
Quicksilver	lb. 230,317	173,769	190,645
value £	16,813	13,611	18,342
Nitre (nitrate of potash)	cwt. 73	6,876	259
Nitre (nitrate of potash)	value £ 70	5,471	271

SPAIN.—That there is plenty of business to be done in Spain is well known, and is proved by the fact that in twenty years German exports to Spain have increased from £117,226 to £3,309,661. During the same period our exports to Spain have decreased from £7,284,633 to £6,831,000, simply because we have had to pay from 20 to 50 per cent. higher duties than the Germans. This unfair discrimination against us is now at an end; besides which, Spain is being largely developed in respect of railways (of which over thirty new lines are being surveyed), mines, and other enterprises. It is quite plain, therefore, that British manufacturers should make every effort to obtain their share of Spanish business.

RUSSIA.—Bicarbonate of nitre (potash) as well as all chemical products mentioned in the text of the tariff, irrespective of degree of purity even though they may be chemically pure, are to be included. A commission is now sitting at St. Petersburg to consider the limitation and control of the output of beet-sugar. The bounty on beet-root sugar is a failure. Russian Phosphorus is said to compete with the British and French article in European markets. The duty is heavy on imported Phosphorus, 114d. a pound, and the Russian manufacturers are estimated to pay 6000 roubles for a quantity yielding 1000 lb. Phosphorus. English manufacturers pay three times that amount, exclusive of carriage. The cost of bones is 104 per cent. in Russia, and 50 per cent. in England of sale price.

ITALY affords a field for the application of skill and enterprise, owing to the enormous waste of sulphur as sulphurous acid from the "calcaroni," and the prospect of economical utilisation in production of superphosphates—since immense layers of 10 to 60 per cent. phosphates are lying near to the sea at Gallipoli. The Italian authorities desire to foster trade whether initiated by foreigners or natives.

UNITED STATES.—"Manure salts" consisting of superphosphates or acid phosphates are to be exempt from duty, as substances expressly used for manure. There are great changes relating to oleomargarine and butter substitutes.

CUBA.—There is an average reduction of 25 per cent. on drugs and chemicals.

FRANCE.—A floating exhibition of French goods will sail from Marseilles *via* Havre, to various ports of South America. A similar undertaking is started at Bordeaux, to visit the West Indian and Northern Coast of South American ports. The port of Calais is now open to imports of mineral oils both raw and refined.

GERMANY.—Extract from a *prices* report from the German Commercial Chambers, on the development of German industry during the last twenty-five years. For facility of comparisons, the first year's product is taken at 100:—

Population	(1860=100 1885=124.1 1861=100 1885=412.5 =371.8 1871=100 1885=602.3 1872=100 1884=133.2 =94.8 1872=100 1884=190.7 =130.2 1866=100 1884=233.3 1872=100 1884=671.1
Output coal	
Value	
Sugar	
Imports	
Value	
Exports	
Value	
Dyeworks	
Saltpetre	

TRADE WITH JAPAN.—British trade in chemicals has decreased forty per cent. German has increased twenty-five to thirty per cent. In 1885, the consumption of heavy chemicals was—Chloride Lime, 81 tons; Caustic Soda, 675 tons; Carbonate Soda, 314 tons; Soda Ash, 125 tons; Soda bicarbonate, 140 tons; Chlorate Potash, 12 tons; Chromate Potash, 56 tons; Amorphous Phosphorus, 60 tons.

CHEMICAL IMPORTS IN JAPAN.—An Austrian Consular Report gives the following statistics of the imports of some leading chemicals and spices in Japan during the years 1884 and 1885. The quantities are given in metric centners of 100 kilos, and the values in dollars:—

ARTICLE.	1884.		1885.		Of which Value was contributed in 1885 by—
	Quantity.	Value.	Quantity.	Value.	
Acid (carbolic) ..	89.1	3,941	144.2	7,323	England, 100 p. c.
.. (salicylic) ..	83.0	30,963	81.1	30,917	England, 30 p. c.; Germany, 60 p. c.; other countries, 10 p. c.
.. (tartaric) ..	115.1	9,852	43.8	3,856	England, 100 p. c.
Alum	5425.6	15,206	3672.0	9,538	England, 15 p. c.; China, 61 p. c.; other countries, 21 p. c.
Bleaching powder	963.5	6,217	1144.0	6,805	England, 100 p. c.
Camphor	32.5	27,158	27.1	21,292	China, 100 p. c.
Cassia and cinnamon ..	1796.1	9,861	1366.2	8,298	China, 89 p. c.; other countries, 11 p. c.
Cloves	426.6	11,677	341.2	8,158	India, 69 p. c.; other countries, 31 p. c.
Glycerine	347.8	10,111	515.0	11,213	England, 54 p. c.; Germany, p. c.; other countries, 2 p. c.
Gypsum	5771.7	7,021	2661.2	3,982	China, 91 p. c.; other countries, 6 p. c.
Hops	20.5	1,018	57.8	1,814	America, 70 p. c.; other countries, 30 p. c.
Morphia	1.0	5,012	1.96	9,001	England, 100 p. c.
Phosphorus (amorphous) ..	72.2	12,018	75.0	12,665	England, 75 p. c.; Germany, 25 p. c.
Potassium (bromide) ..	150.3	10,658	168.7	13,316	England, 29 p. c.; America, 62 p. c.; other countries, 9 p. c.
Potassium (iodide)	147.2	39,698	27.3	12,403	England, 82 p. c.; Germany, 15 p. c.; other countries, 3 p. c.
Quinine	1.216	59,652	2.797	92,918	England, 46 p. c.; France, 27 p. c.; Germany, 19 p. c.; Italy, 4 p. c.; Holland, 3 p. c.
Saltpetre	6851.4	60,392	5216.9	43,505	India, 75 p. c.; China, 15 p. c.; England, 10 p. c.
Santonine	22.30	13,409	16.62	8,508	England, 24 p. c.; Germany, 76 p. c.
Soda (bicarbonate)	4662.7	16,806	5236.7	18,638	England, 89 p. c.; other countries, 11 p. c.
Soda (caustic)	9735.0	37,421	7788.2	29,750	England, 100 p. c.

THE GERMAN POTASH INDUSTRY.—The circumstances of the Stassfurt potash trade are satisfactory, and likely to continue so during the existence of the convention now in force between the producers, but what will occur afterwards—that is, in two years—cannot be said. At present seven mines are comprised in the convention, and as three new works will be likely to join when a re-organisation takes place, it is evident that the working of the convention will in future be a very difficult and complicated matter.

The average length of the German working day, intervals of rest deducted, is 11 to 12 hours, but 10 hours is very common. The variations are considerable. Pomerania, 11 hours; Posen, 10 to 11 hours; Hanover and Schleswig-Holstein, 11 hours; Dresden and Bautzen, 11 hours; Zwickau and Meissen, 11 to 12 hours; Leipzig, 10 to 12 hours; Hamburg, 10 to 11 hours. In the Silesian district of Oppeln; 12 hours in blast furnaces, lead, silver and coke works, dyeworks, etc., in mining 12 hours continuous day and night working in 12 hour relays, 2 hours' rest included; Bavaria, 11 to 12 hours.

COMMERCIAL MUSEUMS are established in Austria-Hungary, 2; Belgium, 5; France, 19; Germany, 17; Holland, 3; Italy, 5; Portugal, 2; Sweden, 1; Switzerland, 3. Most of them have expert pattern samples and information bureaux.

THE CONTINENTAL PARCEL POST.—In consequence of the increasing number of parcels posted for Austria, Hungary, Belgium, Denmark, Germany, Heligoland, and Switzerland, a second daily parcel mail will be despatched to Belgium and to Germany and the other countries named, *via* Ostend, from London on the morning of every week-day. There will be corresponding additional parcel mails from the countries in question to the United Kingdom.

OPENING FOR BOTTLE MANUFACTORY.—There is good opening in New Zealand for a manufactory of bottles. The heavy freights and breakages make them cost here, on an average, three times the home price.

IMPORTATION INTO GERMANY OF CHEMICAL PRODUCTS MADE ELSEWHERE ACCORDING TO GERMAN PATENTS.

It appears that complaints have been made in Germany, and lodged with the higher authorities in Berlin, that chemical products made outside the Vaterland, according to German patented processes, are sent into Germany and sold there. The upshot of this plaint has been that the German Chancellor now sends forth a circular, which appeared in the official "Patent-blatt," No. 39, Sept. 29, 1886, directed to the different Courts of the Empire, showing that chemical compounds manufactured abroad according to methods patented in Germany must be considered as infringing these patents, if such chemicals are imported into Germany, and providing that no other process is known for their production. He further shows that, according to the German Patent Law, not only the manufacture of the article, but also its unauthorised sale, constitutes an infringement. The question that would at once arise as to whether the imported article or compound was manufactured under the German patent, or by some other method, is answered by an instruction to the Courts to consider the case proved, if no other but the patented process is generally known. The onus of proof is thrown upon the party charged with infringement, providing that there is no other process known besides the one patented.

It is almost unnecessary to point out that according to such ruling, if a German patent exist for the manufacture of a chemical substance A, and an English manufacturing chemist discover a new method, or employ a new method for making that substance, and choose to work it secretly, and his product A finds its way into Germany, that English manufacturer would be held to have infringed the German patent in question, and it is hard to see how he could clear himself of the charge and its consequences, whatever they might be, except by patenting his method, or else whispering his secret in German ears.

Monthly Patent List.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

- 13494 J. Dugdill, jun., Manchester. Improvements in alarm apparatus for indicating the level of water or other liquids. October 22
13565 J. Bonthron and R. B. Bonthron, Glasgow. Improvements in and connected with the admission of air to furnaces, also applicable for other purposes. October 23
13571 J. L. Honnart, London. An improved composition for preventing incrustation in steam boilers. October 23
13605 J. Cooke, Halifax. An improved composition for preventing and removing incrustation and corrosion of boilers. October 25
13671 D. M. Weston, London. Improvements in centrifugal machines. Complete specification. October 26
13687 J. Fyffe, Dundee. Raising liquids by compressed air. October 26
13753 J. Newton, Sheffield. Improvements in construction of furnaces. October 27
13789 F. Siemens, London. A combined evaporating and calcining furnace. October 27

- 13795 E. F. Daniel, London. Improvements in apparatus for drawing off liquids from the surface without removing sediment. October 27
13799 W. G. Gard, London. The manufacture of an improved liquid for preventing and removing incrustation in steam-boilers, and treating the product resulting from such manufacture. October 27
13851 J. H. Selwyn and E. Field, London. Improvements in rotary retorts. October 28
13861 J. Bernhardt, London. Improvements in or connected with apparatus for distilling, condensing, heating, cooling and extracting operations. October 28
13886 C. Blagburn and A. Thomson, London. Improvements in apparatus for distilling water for feeding boilers, for ships' use, and for other purposes. October 29
13917 T. G. MacEwen, London. A new or improved governor for the supply of gas or air. October 30
13919 W. Whittle, Smethwick. Improvements in the construction of condensers or vessels for the condensation of steam, and in the application of certain apparatus connected therewith for obtaining motive power. October 30
13959 J. Howie and T. Groves, Glasgow. Improvements in open kilns. October 30
13962 E. J. Pape, Liverpool. Improvements in and relating to the application of zinc to steam boilers and other structures for the prevention of corrosion. October 30
13964 J. A. Watson, London. An improved silica brick. October 30
14082 J. Conacher and O. L. Williams, London—From A. Conacher, United States. Improvements in refrigerating machines. Complete specification. November 2
14141 R. Cunliffe and J. Lund, London. Improvements in apparatus for calcining, drying, or roasting substances or materials, and extracting gases or acids therefrom. November 3
14162 H. T. Yaryan, London. Improvements in vacuum distillation apparatus. Complete specification. November 3
14190 P. H. Bracler, Liverpool. Improvements in or relating to apparatus for obtaining distilled water. November 4
14225 W. Ferguson and W. Hood, Glasgow. Improvements in and connected with liquid strainers. November 4
14261 H. H. Spotton, London. Improvements in meters for measuring liquids. November 5
14271 G. Burton, Birmingham. Improved draw-off taps for discharging in one stream two or more liquors simultaneously, and in any required proportion. November 5
14349 G. Dietrich, London. An improvement in apparatus for promoting consumption of smoke by means of air and steam jets. November 6
14379 W. Burnell, Liverpool. Improvements in furnace and fire bars applicable to marine boilers and every description of furnace. November 8
14415 E. A. Cowper, London. Improvements in filter-presses. November 8
14437 J. W. Hartley, Stoke-on-Trent. Improvements in triturating mills or cylinders. November 9
14468 E. Piot, London. Improvements in distilling apparatus. November 9
14471 H. E. Newton, London—From T. Main, United States. Improvements in steam generators. November 9
14535 C. A. Sahlstrom, London. Improvements in apparatus for burning oil, tar, and similar substances for generating steam and other purposes. November 10
14556 H. E. Edmunds and J. J. Hicks, London. Improvements in flexible chambers or containers to be used for air, gas, steam, water and other fluids, and as substitutes for pistons and cylinders. November 10
14575 F. Hughes, Cheltenham. An improvement in air-tight stoppers and covers for bottles, jars, pots and the cylindrical or oval apertures of chemical, mechanical, or sanitary appliances. November 11
14603 R. Kron, London. Apparatus for sifting granular or fibrous materials suspended in liquids. November 11
14606 J. Quiri, London. Improvements in refrigerating machines and novel binary liquids to be used therein. Nov. 11
14621 T. English, London. Means of maintaining heat and preventing condensation in the cylinders of steam-engines. November 11
14622 E. Taylor, London. Improvements in and relating to refrigerating machines and to the manufacture of ice. Complete specification. November 11
14613 T. Gilmour, Glasgow. Improvements in feed-heating apparatus for steam boilers. November 12
14616 W. E. Gedge, London—From J. E. Carroll, United States. Improved apparatus for heating and purifying feed-water before its introduction into the boiler. Complete specification. November 12
14649 R. Leigh, Bolton. Improvements in covering and protecting glass carboys. November 12
14680 J. Elliott, London. The employment of centrifugal force in combination with filtering pads for expressing fluids from substances and for compressing and moulding such substances. November 12
14690 A. M. Clark, London—From C. S. Wilcox, United States. Improved means of effecting the consumption of smoke in furnaces. Complete specification. November 12
14709 C. Billington and J. Newton, Longport. Improvements in filter presses. November 13
14710 J. Simpson and E. W. Parnell, Liverpool. Improvements in separating liquids from solids, and in apparatus therefor. November 13
14856 O. G. V. Sternberg, London. Improved means and apparatus for the generation and utilisation of motive fluid. November 16
14858 P. Jensen, London.—From Messrs. Hoy and Bussmann,

Hamburgh. Improvements in fire doors for boiler and other fireplaces. November 16

11873 H. H. Lake, London—From M. Hampford and C. C. Hampford, United States. Improvements relating to the cooling of liquids and to apparatus therefor. November 16

11887 D. George, Birmingham. An improvement in creating a draught in boiler flues or chimneys. Complete specification. November 17

11897 T. Bowen, London. Improvements in means or apparatus for facilitating the removal of mud or deposit from steam boilers or like vessels. November 17

11957 J. Barr, Glasgow. Improvements in and connected with valves for controlling the supply or passage of liquids. November 18

11967 E. O. Cooper and W. T. Cooper, London. Removing and preventing calcareous incrustations in steam boilers. November 18

15006 T. Routledge, London—From A. Abadie, France. Improvements in apparatus or appliances for crushing, grinding, triturating, disintegrating, reducing or preparing fibrous materials, or mineral, chemical, oleaginous or other substances. November 18

15022 J. Thomas, Newcastle-on-Tyne. Thomas's boiler incrustation preventor. November 19

15046 T. Lowe, London. An improved spiral mixing machine for liquidising or incorporating mixable ingredients. Nov. 19

15051 J. Lyle, Glasgow. Improvements in furnaces to be heated by the burning of oils or other hydrocarbon fluids in them, and in fittings or appliances connected therewith. November 19

15076 C. A. Sahlström, Aberdeen. An apparatus for projecting oil or other fuel into furnaces in the form of spray. Nov. 19

15125 F. L. Merritt, London. A retort fire-bar to generate water-gas as fuel in furnaces where the ordinary fire-bar is used. November 20

15132 W. Boggett, London. Improvements in evaporating fluids. November 20

COMPLETE SPECIFICATIONS ACCEPTED.*

1885.

11372 A. Bell. Apparatus for use in softening and purifying water. November 23

15282 R. Hammerschmidt. Apparatus for measuring or dividing liquids or gases under high pressure. November 2

15335 G. S. Ullathorne. Valves, etc., for prevention of waste of fluids. November 2

15898 J. T. Griffin—From J. W. Hatch. Improvements in furnaces and apparatus, and in using solid and gaseous fuel. October 26

15928 G. M. Cruickshank—From A. and G. Roth. Tuyeres for forges or hearths. October 29

15957 J. Easby. Improvements in water and other liquid taps. November 12

16016 T. Hudson. Consuming the smoke from the furnaces of steam boilers or evaporators. October 26

1886.

96 T. Fox. Apparatus for generating and utilising gases. November 16

183 E. White. Means for consuming furnace smoke. Nov. 5

397 H. Stockheim. Improvements in filtration and apparatus therefor. November 9

404 J. L. Sampson and J. Hart. Apparatus for feeding fuel to furnaces. November 12

561 J. M. Stanley. Smoke-consuming fireplaces. Nov. 16

699. C. M. Farrow. Taps for viscous fluids. November 16

737 W. Leggett. Apparatus for indicating the heat in ovens, etc. November 16

1001 A. J. Boulton—From G. A. Heiser. Smoke-consuming furnaces and boilers. November 23

1037 J. L. Wade. Compound for preventing incrustation in boilers. November 23

1793 F. Candy. See Class XVII.—B

2517 F. Candy.

11731 W. H. Twine, A. M. D. Churchill, and H. J. Honour. Cocks and valves for steam, water or other fluids under high pressure. October 26

12077 J. R. Alsing. Triturating cylinders. October 26

12112 W. P. Hoblyn. Smoke-consuming stoves and furnaces. November 2

12986 H. C. F. Storer. Apparatus for washing and absorbing gases and for evaporating liquors. November 12

13133 H. H. Lake—From S. Jonsson. Apparatus for limiting the speed of centrifugal apparatus. November 16

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

13501 A. E. Scott, London. An improvement in the manufacture of candles, combining safety, economy, cleanliness and ease in fitting. October 22

13513 D. C. Caddick and J. F. Wake, Middlesborough. The utilisation of waste ashes from all description of furnace grates, and also breeze or coke-dust in the manufacture of fuel blocks for household, steam and general heating. October 23

13578 H. H. Lake—From G. Godeffroy, Germany. Improvements in the preparation of fuel. October 23

13637 R. Combret, London. Improvement in the manufacture of blocks of artificial fuel. October 25

13674 G. T. Chimney, Newcastle-on-Tyne. Process by which the gases or smoke generated by the burning of mineral oils can be used for heating or lighting purposes. October 26

13752 G. T. Chimney, Newcastle-on-Tyne. Apparatus for inducing complete combustion of mineral oil-gases or smoke, to be used for heating or lighting purposes. October 27

13801 Sir E. Green, London. Improvements connected with scrapers for fuel economiser tubes. October 27

13823 F. V. Hadlow, Buxted. An improvement in the artificial manufacture of coal so as to render it comparatively smokeless. October 28

13824 A. Thomson, Glasgow. Improvements in gas fires. October 26

13897 W. T. Sugg, London. Improvements in apparatus for heating by gas. October 29

13922 W. H. Lindsay, London. Improvements in apparatus for moulding coal-dust or small coal into solid blocks. Oct. 29

13912 J. F. Waldie and R. Stewart, Glasgow. Improvements in washing coal, and in the mechanism and apparatus used therefor. October 30

13985 W. H. Lindsay, London. Improvements in the manufacture of artificial fuel. October 30

14077 J. C. Kent and G. Nash, London. Improvements in an apparatus for lessening the consumption of fuel in ordinary house fire grates, fire baskets, and other similar receptacles, while giving increased heat and perfect combustion. November 2

14097 A. Paget, Loughborough. Improvements in apparatus for producing light from gas by rendering incandescent what are known as "mantles," hoods, cones, cylinders, or coverings. November 2

14107 C. Andoy, London. A method and apparatus for manufacturing fuel blocks in form of bullets. November 2

14111 G. Seagrave, London—From P. Fougeron, jun., France. Improved construction and arrangement of carburetted apparatus, to be called "The Photogene." November 2

14191 H. H. Doty, London. Improvements in oxyhydrogen burners, and in the combustion of mineral oils and other hydrocarbons. November 4

14231 J. H. Johnson, London—From C. Goublier, France. Improvements in candles. November 4

14260 J. F. Wright and G. E. Wright, Birmingham. Waste heat extractors. November 5

14265 R. Stewart and J. F. Waldie, Glasgow. Improvements in washing coal or other material, and in the mechanism or other apparatus to be used therefor. November 5

14319 G. Dietrich. See Class I.

14567 G. E. Davis, Manchester. Improvements in the manufacture of gas retorts. November 11

14556 W. H. Bond, Aberavon. Improvements in gas hydraulic mains for displacing and replacing the seals. November 12

14795 J. F. Wright and G. E. Wright, Birmingham. Improvements in waste heat extractors for gas fires. Complete specification. November 15

14933 A. Cockey and W. Smith, London. Improvements in self-acting safety bye-pass gas valves. November 17

14958 W. Burns. See Class III.

14962 H. N. Box and H. Davison, Manchester. Smoke consuming and economising of heat and fuel in furnaces. November 18

14968 C. Y. C. Dawbarn, Liverpool. The improvement of the materials used in fire-lighters. November 18

15007 C. Estcourt, H. Vevers, and M. Schwab, London. An improved continuous process for the purification of coal-gas from sulphur compounds, by which the sulphur is recovered. November 18

15013 J. Lilley and F. Metgé, London. Improvements in the manufacture of artificial fuel. Complete specification. November 18

15081 H. Barclay and R. Simpson, Harrington Iron Works, Cumberland. A new method of treating coal to separate pyrites, shale, and other impurities therefrom, applicable to other industries. November 20

15125 F. L. Merritt. See Class I

15171 T. Richmond, London—From W. Wills, United States. Improvements in apparatus for the separation of smoke from the gases evolved during the combustion of fuel. November 22

15189 A. J. Boulton—From W. P. Lane and A. M. Sutherland, United States. Improvements in the manufacture of gas. Complete specification. November 22

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

13967 J. Roots. Rendering a liquid hydrocarbon gaseous. November 12

14771 S. Koerberthaler. Apparatus for regulating the supply of heat to rooms, etc. November 9

15614 W. Menzies. Combination of powdered and liquid fuel for furnaces. November 16

1880.

803 J. G. Dimelow, H. C. Parkin, and W. Stelfox. Improved heating and illuminating gas stove. October 26

9291 R. Ashton. Self-extinguishing candles. November 23

11063 Apparatus for burning liquid fuel. November 19

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

APPLICATIONS.

- 13929 H. Ellison and G. E. Davis, Manchester. A new and improved method for the distillation of coal-tar, the oils from coke-ovens, and other similar fluids. October 30
 14395 J. Hammond, London. Improvements to the method of and in apparatus for the utilisation of gas-tar. November 8
 14840 J. Young, Stoke-on-Trent. Improvements in coal carbonising or distillation. November 16
 14938 W. Burns, Leith. Improvements in the distillation of tar, oil, resin, and fats, and in the manufacture of illuminating and heating gases from liquid hydrocarbons, and in apparatus for that purpose. November 13

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

- 13780 C. D. Abel, London—From The Actiengesellschaft fur Anilin-Fabrication, Germany. Process for the production of azo colours from orthosulpho or orthocarbonic acid of benzidine. Complete specification. October 27
 14253 J. Annabehn, London. Methods or processes of treating oxynaphthol and aniline, or its homologues, obtaining certain products, and utilising the same in the manufacture of dyes. November 5
 14303 H. H. Lake, London—From K. Oehler. Improvements in the manufacture of azo dye stuffs. November 5
 14625 J. H. Johnson, London—From The Badische Anilin and Soda Fabrik, Germany. Improvements in the preparation of yellow, red, and purple colouring matters. November 11
 15146 T. Bang, Leeds. From Dahl & Co., Prussia. Improvements in the manufacture of red azo dye stuffs or colouring matters. November 22

COMPLETE SPECIFICATION ACCEPTED.

1886.

- 43 C. D. Abel—From C. Roth. Production of colouring matters. October 29

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

APPLICATIONS.

- 13497 G. Tolson and J. Illingworth, Batley. Improvements in machine for carbonising wool, rags, and the like. October 29
 13498 G. Tolson and J. Illingworth, Batley. Improvements in machine for carbonising wool, rags, and the like. October 22
 13606 J. Walker, Halifax. Improvements in apparatus for carbonising fabrics composed of animal and vegetable fibres. October 25
 13608 E. W. Serrell, jun., Paris. Improved process and apparatus for preparing silk cocoons for reeling. Complete specification. October 26
 13711 E. Edwards, London—From H. Wolff, Germany. Improvements in the method of and apparatus for treating hemp, flax, and other plants for the purpose of obtaining textile fibres. October 26
 14117 C. N. Waite, London. Compound for preparing starch or flour size for yarn, textile, or other fabrics. Complete specification. November 2
 14200 W. Scott, London. Improvements in the treatment of fibre and manufacture of textile fabrics. November 4
 14367 E. W. Serrell and E. Fougeirol, Paris. Process and machinery for preparing silk cocoons for reeling. Complete specifications. November 8
 14610 A. C. Henderson, London—From La Société C. Vignet, ses fils, et Cie., France. Improvements in the method of and in apparatus for dressing or sizing textiles. November 11
 14647 C. Halter and J. Halter, London. Improvements relating to the treatment of fibre and to the manufacture of imitation straw plait therefrom. Complete specification. November 12

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 15917 F. Candy. Preparation of Fuller's earth. October 29
 15918 F. Candy. Treatment and utilisation of a certain kind of Clay. October 29
 15953 A. Hieronimus. Size or dressing material for textiles and fabrics, and for polishing twine, etc. October 29

1886.

- 181 A. L. Cochrane, A. Cochrane, and W. Cochrane. Heat and drying fibrous and textile materials. November 5
 564 O. Chemin. Treatment of animal fibres to remove vegetable matters therefrom. October 29
 6357 J. Campbell. Method and apparatus for oiling wool and other fibre. November 19
 14755 E. Donner and E. Corssel. Treatment of cocoons preparatory to unwinding the silk therefrom. November 2

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

- 13598 J. Fletcher, Manchester. Improvements in dyeing tissue and other papers, and in apparatus therefor. Complete specification. October 25
 13814 A. Aykroyd, W. E. Aykroyd, and J. Smith, Liverpool. Improvements in aniline black dyeing or printing processes, for obtaining a fast aniline black in textile fibres and fabrics. October 28
 14316 A. S. Young, Manchester. Improvements in apparatus for printing upon calico and other similar woven fabrics. November 6
 14127 D. A. Louis, London. Improvements in bleaching vegetable fibres and tissues. November 9
 14673 E. Hernite, E. J. Paterson, and C. F. Cooper, London. Improvements in apparatus for the preparation of bleaching solutions by electrolysis. November 12
 14698 E. Edwards, London—From E. Decock, Roubaix. Improvements in machinery or apparatus for dyeing skeins or hanks of wool, cotton, jute, flax, silk, or other fibrous materials. November 12
 14971 E. Sutcliffe and G. E. Sutcliffe, Halifax. Improvements in machinery or apparatus for bleaching, damping, and dyeing loose fibre yarns, threads, or other fibrous materials. November 18

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

- 83 W. Bracewell. Apparatus for bleaching kiers. November 2
 359 F. W. Hudson and F. W. Schroeder. Scouring, washing, chroming and dyeing woven or felted fibre. November 9

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

- 15762 W. Bramley and W. P. Cochrane, Redcar. The manufacture of hydrated carbonate of magnesia, and other products. October 27
 14141 R. Cunliffe and J. Lund. See Class I.
 14247 J. B. Hannay, Glasgow. Improvements in the manufacture of sulphuric acid. November 5
 14343 L. Mond, Liverpool. Improvements in or relating to the manufacture of caustic soda or caustic potash from the respective carbonates. November 6
 14344 J. W. Kynaston, Liverpool. Improvements in or relating to the manufacture of chlorate of potash. November 6
 14372 W. Bramley, Middlesbrough-Tees. Improvements in and relating to the manufacture of alkaline carbonates and chlorine. November 8
 14414 W. Burns, Leith. Improvements in the manufacture of sulphuric acid under high pressure, with agitation, and in apparatus for that purpose. November 9
 14710 J. Simpson and E. W. Parnell. See Class I.
 14711 J. Simpson and E. W. Parnell, Liverpool. Improvements in apparatus for use in the treatment of sulphuretted hydrogen for the separation of sulphur, or for the production of sulphurous acid. November 13
 14732 D. B. Hewitt and Brunner, Mond & Co., Limited, Liverpool. Improvements in the manufacture of caustic soda or caustic potash. November 13
 14790 F. Bale, Droitwich. Improvements in the manufacture and production of ammonia, hypochlorous acid, and hypochlorites, and in the apparatus employed therein. November 15
 14875 J. R. Francis and F. F. Jones, London. An improved process and apparatus for obtaining sulphur and other substances from ores, for purifying such substances, and for similar purposes. November 16
 15007 C. Estcourt, H. Vevers, and M. Schwab. See Class II.
 15182 E. P. Alexander, London—From E. J. L. Delsol, France. A process for obtaining mother liquors free from magnesium salts in the manufacture of carbonate of potash by means of the double carbonate of potash and magnesia. November 22

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 15661 T. R. Shillito—From E. Hänisch and M. Schroeder. Separating substances from phosphate of lime. October 29

1886.

- 17 E. W. Parnell and J. Simpson. Manufacture of carbonate of soda, with production of sulphuretted hydrogen. November 2
 150 T. Robinson. Manufacture of alum and sulphate of alumina. November 9
 150 J. Addie and J. Addie. Production of sulphurous acid gas.
 227 N. Mathieson and J. Hawliczek. Manufacture of bicarbonate of soda and soda ash. November 12
 1050 W. Bramley. Manufacture of carbonates or bicarbonates of sodium or potassium from their sulphates. November 23

- 9276 E. Bohlitz and G. O. Heyne. Separating waste lye containing chlorate of magnesium into hydrochloric acid and magnesia, for producing carbon magnesia for use as a decolorising and disinfecting agent. October 29
 12255 T. Raynaud. Producing hypsulphite of soda. November 23

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

- 14216 A. M. Clark, London.—From E. Weis, Bohemia. An improved process for cutting very thin parts upon glass articles. November 1
 14239 G. Ingram, Wolverhampton. Improvements in the construction of crowns for glass furnaces. November 3
 14288 G. F. Chance, London. Improvements in or additions to machinery employed in the manufacture of sheets of rolled glass. November 5
 14330 W. Boulton, London. Improvements in the manufacture of various articles of pottery, having straight parallel sides. Complete specification. November 6
 14380 A. D. Brogan and A. M. Malloch, Glasgow. Improvements in the manufacture of chequered glass, and in apparatus therefor. November 8
 14727 H. M. Ashley, Ferrybridge. Improvements in the manufacture of bottles, and other articles of glass. November 13
 14779 W. H. Blessley, Middlesborough. The manufacture of iron stoneware. November 18
 15099 J. D. Watson, Glasgow. An improved method of annealing glass or articles manufactured therefrom. November 20
 15141 T. Kilner, Halifax. Improvements in the manufacture of bottle necks, and in apparatus employed therein. November 22

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 14168 T. Bolas. Imprinting devices on glass, stone, pottery, enamel, etc., which will stand the action of fire. November 5
 15743 H. Standen. Manufacture of glass for sanitary purposes. November 5

1886.

- 358 The Hon. D. Lawless. Producing designs on pottery, glass, etc. November 23
 13132 E. Moore. Improvements in connection with the annealing hear of a flint glass house. November 16

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

- 13511 R. Briggs and others. See Class X.
 13512 F. C. C. Hewett, E. P. Reeve, and W. P. Davis, London. Improvements in apparatus for turning and exposing drugs, grain, cement, and other materials, for the purpose of drying, cooling, or otherwise treating the same. October 22
 13616 R. Scholefield, London. Improvements in or relating to machinery or apparatus employed in the manufacture of bricks, tiles, and other forms. October 25
 13618 R. G. Burstenbinder, London. Improvements in saturating wood. Complete specification. October 25
 13881 W. H. Lindsay, London. Improvements in apparatus for moulding bricks or blocks. October 30
 14312 T. Arnold, Stockton-on-Tees. Improvements in the process of and apparatus for moulding briquettes of cement, or the like material, to be employed for testing the qualities thereof. November 6
 14434 G. Howard, London. Improvements in decorating wood. Complete specification. November 9
 14527 T. Cox, London. The following methods of fixing, without mortar and cements, panels, tiles, bricks, borderings, fillets, cornices, etc., so that they can be fixed to ceilings, frames, walls, etc., so that there are no nails, screws, or cement mortar joints shown on the fronts; to be made with all kinds of clay, slugs, glass, woods, etc. November 10
 14674 W. Scott, C. Swan & Co., W. Whamond, and T. Gibb, London. Improvements in the manufacture or treatment of Portland and other hydraulic cements. November 12
 14972 T. C. Fawcett, Halifax. Improvements in machinery for pressing bricks, brickettes, tiles, and other articles. November 18
 15012 H. Macevoy, H. Holt, L. White, and W. Wilders. Improvements in the manufacture and burning of Portland cement. November 18
 15211 J. Y. Johnson, London.—From E. Coignet, France. Improvements in the preparation and treatment of beton or concrete, and in the apparatus employed therein. Complete specification. November 22

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 15877 J. Dejaiffe. Process and apparatus for dressing, squaring and polishing stone, etc. November 9

1886.

- 31 W. Joy. Utilisation of the waste heat from cement and lime kilns. October 29
 616 J. Howie. Chambers for drying bricks and clay ware. November 16
 8418 W. G. Woodson and R. Skeoch. Manufacture of bricks, ridge tiles, etc. November 9
 14091 J. C. Anderson. Manufacturing bricks, tiles, etc., from pulverulent materials.
 14629 C. J. Heaton. Manufacture of ornamental cloisonné work, specially applicable to building purposes. October 29

X.—METALLURGY, MINING, ETC.

APPLICATIONS.

- 13481 W. Galbraith, Glasgow. Improvements in the treatment of and in the separation and recovery of iron from phosphatic slags and minerals. October 22
 13483 B. H. Thwaite, Liverpool. Improvements in the pneumatic process of manufacturing steel ingots and castings. October 22
 13502 E. Wheeler, London. Improvements in the production of compound ingots. October 22
 13503 E. Wheeler. Improvements in the production of metal bodies or ingots, and in the method of producing the same. October 22
 13511 R. Briggs, J. Briggs, T. S. Briggs, and R. W. Briggs, London. Improvements in kilns for burning limestone and calcining metallic ores, cement, and other substances. October 22
 13531 A. G. Greenway, Liverpool. Improvements in the manufacture of iron and steel. October 22
 13539 S. Morley, Horsforth, Yorks. Safety of miners after an explosion from the effects of after-damp. October 22
 13562 P. M. Justice, London.—From W. B. Spear, United States. Improvements in and connected with the coating of metal sheets with metal. October 23
 13561 W. Martin, Glasgow. Improvements in and connected with the manufacture of malleable iron. October 23
 13572 W. Banks and S. Brierley, London. A new or improved miner's safety lamp. October 23
 13590 J. Macnab, London. Improvements in safety lamps for miners and other purposes. October 23
 13654 L. Grabou, London. Improvements in the manufacture of fluoride of aluminium, and the double fluoride of aluminium, and an alkali. October 25
 13658 W. Elmore, F. E. Elmore, and A. S. Elmore, London. Improvements in and apparatus for the treatment of tin scrap and the like, and the obtainment therefrom of oxide of tin and oxide of iron. October 25
 13680 B. C. Tilghman, London. Improvements in drawing iron and steel bars through dies, to produce a smooth surface suitable for shafting. October 26
 13682 J. R. Turnock, Loughor. Improvements in machinery for coating metal plates or sheets. October 26
 13686 J. Laidler, Durham. Improvements in safety or miner's lamps. Complete specification. October 26
 13793 E. J. H. E. Whitehouse, London. Improvements in annealing pots. October 27
 13869 H. Levetus and M. Wilkins, Birmingham. An improved metallic alloy. October 29
 13920 T. Nordenfelt, London. Improvements in the manufacture of castings in iron and steel. October 29
 13928 J. E. Baugh and C. Hinksman, London. Improvements in the humid reduction of gold and other ores. October 30
 13938 J. Butler and J. Evans, Manchester. Improvements in and in apparatus for forming moulds in which articles or frames of polyhedral, cubical, or other analogous forms may be formed by casting. October 30
 14009 J. A. Ramsay, London. Improvements in purifying the atmosphere of coal mines. November 1
 14020 J. T. Dunn, London.—From A. Schaag and Messrs. Flurscheim & Bergmann, Germany. An improved method of galvanising iron and steel. November 1
 14022 A. Brin and L. Q. Brin, London. Improvements in and apparatus for the treatment of tin scrap and the like, and the obtainment therefrom of oxide of tin and oxide of iron. November 1
 14061 J. B. Hannay, Glasgow. Improvements in obtaining gold from refractory ores or other auriferous substances. November 2
 14136 E. H. Cowles, London.—From the Cowles Electric Smelting and Aluminium Co., United States. Improvements in separating aluminium from tin, silver, and other metals and alloys. November 3
 14156 A. Wylie, London. Improvements in machinery and appliances for the manufacture of pipes or rods from metallic alloys or compounds thereof. Nov. 3
 14169 T. Nordenfelt, London. In part from C. G. Wittenstrom, E. Faustman, and P. Ostberg, Sweden. Improvements in Bessemer converters and in the manufacture of castings thereby. Nov. 3
 14220 R. W. Lindsay and W. Darwen, London. Improvements in the manufacture of tubes of copper or alloys of copper. Nov. 4
 14258 A. Schmole, Berlin. A method of separating the injurious ferruginous alloys of tin contained in baths of tin in tinning iron articles. Complete specification. Nov. 5
 14281 R. K. Boyle, London. Improvements in and means for electro-plating or coating metallic surfaces with metals. Nov. 5

14297 J. Nicholas, London. An improved method of smelting and recovering metals from ores and dross. Nov. 5
 14398 J. Harris-James, Cornwall. An improved process of crushing and dressing tin and other ores, and improvements in machinery therefor. Nov. 6
 14432 E. C. Ibbotson, Sheffield. An improved system (connected with mining) for the separation of free metals from their ores, or from debris, or from foreign matter connected therewith. Nov. 6
 14333 R. Began, London. Improvements in cleansing tin andterne plates, and in machinery therefor. Nov. 6
 14385 E. Patterson and W. H. Strype, London. Improvements in miners' safety lamps. Nov. 8
 14386 T. H. Rees, London. Improvements in the manufacture of metal tiles, and method of fixing the same in position. Nov. 8
 14397 A. L. Underwood and A. E. Carroil, London. Improvements in the manufacture of steel or malleable castings and forgings. Nov. 8
 14407 O. M. Thowless, London. Improvements in the manufacture of aluminium chloride and in the extraction of aluminium therefrom. Nov. 8
 14405 O. M. Thowless. Improvements relating to solutions for use in the electro deposition of aluminium and to substances for use in the preparation of such solutions. Nov. 8
 14419 J. Morrison, Stockton-on-Tees. An improved blast. Nov. 9
 14559 G. L. Brückmann, London. Improvements relating to the manufacture of iron and steel. Nov. 10
 14568 A. Howat, Manchester. Improvements in electric safety lamps. Nov. 11
 14600 J. E. Bennet, London. Improvements in the treatment of metallic chlorides for the extraction of metals therefrom. Nov. 11
 14612 F. W. Paul, Glasgow. Improvements in making steel. Nov. 12
 14639 J. E. Brooks, Glasgow. Improvements in blast furnace charging apparatus. Nov. 12
 14714 C. Todd, London. Extraction of gold from crushed quartz. Nov. 13
 14760 H. H. Lake, London—From R. de Montgelas, United States. Improvements relating to the preparation of metallic magnesium by electrolysis, and to solutions therefor. Complete specification. Nov. 13
 14772 J. Whitehead, Manchester. An improvement in the manufacture of composite wrought iron and cast steel forgings. Nov. 15
 14799 G. W. Wade, London. An improved blast or exhaust fan. Nov. 15
 14833 C. M. Pielstickier, London. Improvements in machinery for the production of metal plates and bars direct from the molten metal. Nov. 16
 14843 W. Thornycroft, Glasgow. Improvements in the treatment of certain kinds of slag to convert the same into a valuable product. Nov. 16
 14903 J. G. Cranston, Newcastle-on-Tyne. Improvements in machinery for drilling rock, coal, and other minerals. Nov. 17
 14921 A. N. J. Contarini, London. Improvements in safety lamps for coal mines. Nov. 17
 14927. J. R. Whitney, London. Improvements in and connected with "chills" employed in casting metals. Complete specification. Nov. 17
 14928 J. R. Whitney. Improvements in and connected with the casting of metals. Complete specification. Nov. 17
 14952 D. Edwards, R. Lewis, and P. Jones, Swansea. Improvements in apparatus used in coating iron, steel, and other metal plates with tin or other metal or alloys. Nov. 17
 14974 M. Settle, Manchester. Improvements in electric safety-lamps for use in mines and other places. Nov. 18
 14988 P. Higgs, London. Improvements in the amalgamation of gold and other ores. Nov. 18
 15001 A. M. Clark, London—From H. A. Brustlein, France. A process and apparatus for hardening shells and other hollow articles of steel. Nov. 18
 15010 P. Rogers and J. Player, Swansea. Automatic machines for coating metal plates and sheets with tin, lead, or other metals, or any alloys of the same. Nov. 19
 15097 D. P. G. Matthews, Newport. Improvements in and connected with the manufacture of ingot moulds, together with improvements in the treatment when in operation of all ingot moulds at present in use, and apparatus in connection therewith. Nov. 20
 15123 G. C. Sillar and L. S. Powell, London. Improvements in incandescence lamps for use in mines or other places. Nov. 20
 15154 J. T. King, Liverpool—From H. Kennedy, United States. Improvements in the manufacture of mineral wool and in apparatus therefor. Complete specification. November 22
 15205 G. A. Dick, London. Improvements in the manufacture of tubes and rods from copper and certain alloys thereof, and in apparatus therefor. Nov. 22
 15205 B. C. Molloy, London. Improvements in apparatus for amalgamating gold and other precious metals. Nov. 22
 15209 T. Fenwick, London. Improvements in the electro deposition of metals.

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

11732 J. Woods. Furnaces for forging. Oct. 29
 15355 J. Spencer and C. Robinson. Apparatus for turning steel ingots or slabs in connection with cogging or rolling mills. Oct. 26

1886.

608 H. F. Dale—From The Tabor Concentrator Co. Ore concentrators. Nov. 9
 785 R. C. de Walcher-Myrdal. Apparatus for facilitating mining and quarrying minerals. Nov. 19
 1027 T. J. Greenway. Separating the precious metals from lead. Nov. 16
 2560 A. T. Davies, T. H. Griffiths, and D. Griffiths. Manufacture of tin and other coated metal plates, and apparatus therefor. Nov. 2
 2816 T. Longmore and J. Tibbitts. Means for forging certain articles of metal, especially applicable in the case of T's, plags, flanges, etc. Nov. 19
 9741 A. J. Boulton—From E. Hamelius. Improvements in cupolas and blast furnaces. Nov. 5
 11089 H. Saek. System of rolls for rolling H and similar iron. Oct. 26
 12302 J. Whitley. Construction of bronze guns and other ordnance. Nov. 9
 12371 W. H. Follett. Plant for casting steel ingots. Nov. 5
 12326 H. H. Lake—From J. Illingworth. Moulds for use in the manufacture of armour plates. Oct. 29
 12541 R. Miller and N. E. Maccallum. Furnaces for the manufacture of steel.
 12636 B. J. B. Mills—From N. W. Perry. Detectors for marsh gas and other hydro-carbon gases. Nov. 5
 13265 E. Walsh, jun. Blast furnaces. Nov. 19

XI.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

13765 J. Stott, London. Improvements in apparatus for straining oil and other analogous liquids. October 27.
 13865 A. Macalister and W. Stuart, Glasgow. The preparation of iodised oil. October 29
 13979 A. G. Wass, London. An improved lubricant. October 30
 14046 F. Walton, Twickenham. Improvements in the manufacture of moulded articles in oxidised oil compounds. November 1
 14053 A. Macalister, and W. Stuart, Glasgow. Improvements in the manufacture of soaps and glycerine. November 2
 14382 H. Mackay, London. Improvements in the preparation of oils for medicinal purposes. November 8
 14629 C. A. Gosnell and C. P. Gosnell, London. Improvements in branding or marking soap. Complete specification. November 11
 14729 H. Mackay, London. Improvements in the preparation of oils for medicinal purposes. November 13
 14835 F. T. Archer, G. W. Hardy, and F. J. Archer, London. An improved lubricating composition. November 16
 14884 A. Macarthur, Glasgow. An improved wash or dip for sheep and other animals, the same being applicable for washing fabrics and other materials. Complete specification. November 18

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

326 C. D. Abel—From The Fabrik Chemischer Produkte Actien Gesellschaft. Preparation of lanolin and anhydrous lanolin from waste liquors of wool washing and from wool fat. November 9
 419 J. G. Johnson—From C. L. Baillard. Preparation of oils for treating wool, and the manufacture of soap, lubricants, and mordants. November 19
 510 A. Brimstein. Method and apparatus for obtaining alizarin oil from oleaginous seeds. November 23
 1026 R. Hutcheson. Manufacture of lubricants. November 16
 1113 R. Park and J. E. Park. Manufacture of soap. October 26
 4625 T. B. Harrison. A wash or compound for cleansing painted or other articles. October 26
 11138 T. Berliner. Method and apparatus for extracting fat from bones. October 29

XII.—PAINTS, VARNISHES, AND RESINS.

COMPLETE SPECIFICATION ACCEPTED.

1886.

11688 H. Mason. Varnish for boots and shoes. October 26

XIII.—TANNING, LEATHER, GLUE AND SIZE.

APPLICATIONS.

13636 T. Palmer, London. Improvements in purifying and graining hides and other skins, and in apparatus employed therein. October 25
 13775 C. J. Palmer, London. Killing the lime, fat, grease, and other deleterious compounds in hides, kips, or skins. October 27
 13833 J. R. Tussaud, London. Improvements in obtaining the separation of wool, hair, feathers, or other covering from the skins of animals, and in securing the same in position when separated. October 28

14683 J. W. Aborn and J. Landin, London. An improved method of tanning hides and skins. November 12
14916 E. A. Brydges, London. Treating and preserving hides and skins. Complete specification. November 17
15200 H. H. Lake, London—From A. Millochau and F. Chailly, France. An improved process of tanning. Complete specification. November 22

XIV.—AGRICULTURE, MANURES, ETC.

APPLICATIONS.

14301 H. H. Lake, London—From Terceclin, Briart, & Co., Belgium. Improvements relating to the manufacture of chemical manures. November 5
15019 D. Smith, Inverness. An improved self-feeding kiln fire apparatus for drying corn, using the husks as fuel. November 19

XV.—SUGAR, GUMS, STARCHES, ETC.

APPLICATIONS.

13566 W. T. Crooke, London. Improvements in the method of cleansing pockets or bags employed in the manufacture of sugar, and in the means employed therefor. October 20
14117 C. N. Waite. See Class V.

COMPLETE SPECIFICATION ACCEPTED.

1886.

1820 L. Cuisinier. A new diastase saccharine substance, and method of making the same. October 26

XVI.—BREWING, WINES, SPIRITS, ETC.

APPLICATIONS.

13678 J. Bonthorne and R. B. Bonthorne, Glasgow. Improvements in the washing of malt for brewing and distilling, and in the machinery therefor. October 26
13738 H. H. Lake, London—From J. W. Free, United States. Improvements relating to the manufacture of malt, and to apparatus therefor. Complete specification. October 26
14079 F. Faulkner and W. Adam, London. Improvements in vessels for use in brewing beer, porter, and other like malt liquors, and applicable also for use in the manufacture of vinegar and other like analogous processes. November 2
14092 G. P. Wheeler and F. Ritter, London. An improved non-alcoholic beverage. November 2
14191 J. H. Woodward, London. Improvements in apparatus for drawing off and aerating wort, in the manufacture of vinegar, and in brewing and other like and analogous processes. November 4
14257 J. Williamson, Glasgow. Improvements in preparing yeast for the better preservation of the same. November 5
14302 A. G. Fraser and G. Epstein, London. Improvement in the treatment of distillers' and brewers' worts. November 5
14342 A. J. Boulton, London—From C. F. Elze, Germany. Improvements in beer refrigerators. Complete specification. November 6
14360 S. Fulda, London. Improvements in preserving and clarifying ale, beer, porter, stout, cider, cordials, water and other sweetened and unsweetened, fermented, and unfermented beverages and liquids. November 6
14390 Messrs. Gottsmann Brothers, London. Improvements in or relating to the refining of lager beer. November 8
15175 J. C. Mewburn—From L. Teilliard. See Class XX.
15188 H. H. R. Jensen, W. B. Mears, and J. Brunt, London. Improvements in the treatment of yeast. November 22

COMPLETE SPECIFICATION ACCEPTED.

1886.

783 D. A. F. Bang and M. C. A. Ruffin. Process and apparatus for the purification of alcohol. November 9

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, ETC.

APPLICATIONS.

A.—CHEMISTRY OF FOODS.

13734 E. Serrant, London. Manufacture of a biscuit bread. October 26
13742 H. H. Lake, London—From P. B. Rose, United States. The manufacture of an article of food. Complete specification. October 26
13758 J. Marshall and T. A. Marshall, Glasgow. Improvements in preparing a nutrient or digestive and medicinal substance from malt. Complete specification. October 27
13955 H. Stockman, North Sunderland. Improvements in the processes of curing articles of food and disinfecting. October 30

14285 R. Low, London. Improved mode of preparing food from cereals. November 5
14391 B. J. B. Mills, London—From S. S. Serrier, Belgium. An improved apparatus and process for making coffee. Complete specification. November 8
14472 S. Pitt, London—From J. M. Hughes, United States. A new and useful mixture of salt and phosphate of lime for table use as a condiment for seasoning food. Complete specification. November 9
14610 S. French, London—From T. J. Richman and A. M. Plumb, United States. A process for extracting butter from milk, and for manufacturing butter. November 12

B.—SANITARY CHEMISTRY.

13791 P. A. Ames, London. Deodorising sewage in large quantities at its outfall, known as the "Ames" process. October 27
13829 F. Candy, London. Improvements in the manufacture of materials for use in the treatment of sewage in order to the separation or removal by precipitation or otherwise of the matters in suspension and solution in the water thereof, and in the clarification and purification and deodorisation and decoloration by precipitation or otherwise of other polluted water, and certain other liquids. October 28
14138 T. Hewson, Leeds. A cheaper and better means of destroying or rendering innocuous by fire the combustible refuse of towns usually collected by local authorities. November 3
14221 T. Donnithorne, London. Improvements in the treatment of sewage. November 4
14109 A. Forrest and W. Walsh. Machines for drying and powdering blood, sewage, etc. November 2
14820 G. H. Leane. Use of carbon in the compression of sewage sludge. November 2
530 J. C. Bothams. Apparatus for extracting sewage sludge from tanks in which it is precipitated. November 19
775 C. Blagburn. Vessels for carrying sewage, etc. Nov. 23
907 A. Howatson. Methods of arranging plates, etc., in vessels for separating solid impurities from liquids. Nov. 23

C.—DISINFECTANTS.

14684 H. E. Harris, London. Improvements in the method of applying and manufacture of antiseptic, disinfecting, curative, and healing agents. November 12
15201 J. Watt, London. An improved deodorising material. Complete specification. November 22

COMPLETE SPECIFICATIONS ACCEPTED.

A.—CHEMISTRY OF FOODS.

1886.

9322 F. P. Warren. Improved food for animals. November 9
14732 A. B. Lester and A. Meaby. Preparing malted wheat and other cereals (barley excepted), and employing them in the manufacture of food. November 9

B.—SANITARY CHEMISTRY.

1885.

15861 F. R. Conder. Application of iron compounds for the purification of water, and other sanitary purposes. November 16
15895 C. D. Abel—M. M. Rotten. Apparatus for purifying effluent waters from factories, sewers, etc. November 5

1886.

1793 F. Candy. Filtering media for the purification of liquids and gases. October 29
2517 F. Candy. Filtering materials and precipitants. October 29
8871 J. Bannehr. Treating sewage and other polluted waters. November 2
9276 E. Bohlilg and G. O. Heyne. Process for manufacturing carbon magnesia from lyes of magnesium chlorate, for cleansing spent lyes and sewage and rendering same innocuous. October 29
12075 G. E. Leane. Apparatus for filtration of sewage, etc. October 29

C.—DISINFECTANTS.

1886.

591 T. Bradford. Disinfecting, and apparatus therefor. November 16

XVIII.—ELECTRO-CHEMISTRY.

APPLICATIONS.

13515 E. J. Houghton, London. Improvements in charging accumulators by dynamo machines. October 22
13529 R. Oakley, London. Improvements in apparatus for filling and emptying the cells of batteries. October 22
13591 M. Bailey and J. Warner, London. An improved method of preventing the escape of noxious fumes from batteries used for electrical purposes. October 23

13592 M. Bailey and J. Warner. Improvements in primary batteries. October 23
 13618 W. H. Johnston, London. An improvement in the manufacture of carbons for electrical and other purposes. October 25

13665 G. Quarrie, London. Improvements in and apparatus for producing electricity for lighting, motive power, and other purposes. October 26

13712 A. M. Clark, London—From the Electrotechnische Fabrik, Caunstatt, Germany. An improvement in dynamo-electric machines. October 26

13910 G. Quarrie, Liverpool. Improvements in or relating to the production of electricity and apparatus therefor. October 29

13987 J. G. Statter, S. L. Branton, and J. W. Kempster, London. An improved collector or brush for dynamo-ormagneto-electric machines or motors. October 30

14033 C. D. Abel, London—From Messrs. Siemens and Halske, Germany. An improvement in electrolysis. November 1

14101 A. B. Holmes and J. C. Vaudrey, London. Improvements in frictional gearing for driving dynamo electrical machines. November 2

14211 G. Sengrave, London. Improvements relating to the preparation under partial vacuum of organic substances, in order to render them capable of being electro-plated. November 4

14269 R. E. B. Crompton, London. Improvements in galvanometers. November 5

14280 W. H. Tasker and T. J. Jones, London. Improvements in voltaic batteries. November 5

14286 A. Wunderlich and O. Eisele, London. A new or improved galvanic battery. November 5

14345 H. Tudor, Liverpool. Improvements in electrodes for accumulators or secondary batteries. November 6

14352 J. Wolicka, London. Improvements relating to the armatures of dynamo-electric machines and electro-motors. Complete specification. November 6

14398 L. Bollmawa, Vienna. Improvements in dynamo-machines and electric motors. November 8

14408 O. M. Thowless. See Class X.

14521 J. J. C. Rappard, London. Improvements in dynamo-electric or magneto-electric machines. November 10

14533 J. S. Sellen, London. Improvements in secondary batteries. November 10

14673 E. Hermite, E. J. Paterson, and C. F. Cooper. See Class VI.

14757 W. Lahmeyer, London. An improved dynamo-electric machine. November 13

14760 H. H. Lake—From R. de Montgelas. See Class X.

14765 C. Lever, London. Improvements in dynamo-electric machines and electro-motors. November 15

14937 M. Bailey and J. Warner, London. An improved method of preventing the escape of noxious fumes from batteries used for electrical purposes. November 17

15039 G. Hookham, Birmingham. Improvements in dynamo-electric machines with slotted armatures. November 19

15031 G. Hookham. Improvements in the commutators of dynamo-electric machines. November 19

15202 L. Grabat, London. Improvements relating to the smelting or reduction of ores and similar materials by means of electricity, and to apparatus therefor. November 22.

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

13422 W. A. Barlow—From M. Sappey. Galvanic battery and apparatus for automatically supplying liquids thereto. November 2

13594 J. P. Reeves and T. D. C. Parker. Voltaic batteries. November 5

13951 G. Tolman and H. Deaton. Dynamo-electric machines. November 16

15268 C. J. Bosanquet, W. Cameron, and W. A. Tomlinson. Appliances for regulating the electro-motive force of currents and the speed of motors. November 9

15421 O. E. Woodhouse, F. L. Rawson, J. H. Davies, and E. J. Moynihan. Apparatus for measuring electric resistances. November 23

1886.

335 D. G. FitzGerald. Voltaic batteries. November 9
 611 O. Imray—From A. Khotinsky. A secondary voltaic battery. November 16

1054 J. H. Noad and R. Matthews. Improved formation of plates with composition for electric batteries. November 23
 7028 G. F. Rose. Primary electric batteries. November 2
 12169 G. C. Tricker. Dynamo-electric machines. November 12

XIX.—PAPER, PASTEBOARD, ETC.

APPLICATIONS.

13533 A. Schmidt, London. Improvements in the manufacture of certain kinds of fancy paper. October 22

13827 B. Makin, London. An improvement in fitting cylinders with blades used in the process of macerating materials for pulp in the manufacture of paper, millboards, and kindred products. October 28

13855 G. Bodlander and J. ranbe, London. Improvements in the manufacture of copying paper. October 28

14271 W. Rogers, Liverpool. Improvements in the preparation or treatment of paper for copying written letters, documents, and the like, and chemical preparation or compound therefor. November 5

14300 A. G. Hehre and O. G. Hehre, London. Method of and machinery for pressing paper pulp into long ornamental and other mouldings. Complete specification. November 5

14580 H. A. Perry, Brighton. Sizing paper hangings, or varnishing same. November 11

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

APPLICATIONS.

13770 S. Travado, London. Toilet purposes called the "Oriental aromatic salts." October 27

14617 O. Imray, London—From the Society of Chemical Industry, in Basle, Switzerland. Manufacture of the ethylether of a new acid. November 11

14618 O. Imray—From the Society of Chemical Industry Basle. Manufacture and treatment of a compound of phenyl hydrazine with a new ethylether. November 11

15175 J. C. Mewburn, London—From L. Seilliard, France. Improvements in and apparatus for the manufacture of ozone, and its application to the purification or treatment of alcoholic liquids and other similar purposes. November 22

XXI.—EXPLOSIVES, MATCHES, ETC.

APPLICATIONS.

13334 H. S. Maxim, London. Improvements relating to cartridges, projectiles, and fuses, to means for regulating the action of such fuses, and to apparatus for use in the manufacture of the said projectiles. October 22

14219 G. Smith, Glasgow. Improvements in electrical fuses. November 5

14478 W. Lorenz, London. An improvement in percussion caps or capsules for metallic cartridge cases. November 9

14495 G. Teideman and H. S. Price, London. An improved fusee. November 10

14623 C. E. Bichel, London. Improvements in the manufacture of explosive compounds. Complete specification. November 11

14693 H. H. Lake, London—From E. Franke, Germany. Improvements relating to the manufacture of explosives. November 12

14803 Sir F. A. Abel, London. A manufacture of smokeless explosive. November 15

15111 W. Lorenz, London. Improvements in compressing powder and other compressible explosives in cartridge cases and other receptacles, and in appliances therefor. November 20

15118 C. H. Russell, London. An improved manufacture of matches. November 20

COMPLETE SPECIFICATION ACCEPTED.

1886.

112 H. A. Schlund and A. Martin. Percussion fuses. November 5

THE JOURNAL OF THE Society of Chemical Industry:

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NOTICES.

The supply of copies of the Journal for January, 1887, being now exhausted, the Secretary would be glad to receive communications from members possessing extra copies of that number, in good condition, with a view to purchase.

Should sufficient applications for complete sets be received, the number will be reprinted.

Members are hereby advised that the Subscription of 25s. for 1887 is now due, and should be paid as early in the year as possible. Cheques and orders should be made payable to Mr. E. Rider Cook, and forwarded either to him at the East London Soap Works, Bow, E., or to the General Secretary.

Authors of communications read before the Society or any of its Local Sections are requested to take notice that, under Bye-Law 43, they cannot receive the prescribed 50 copies of their communications unless they comply with the condition laid down in that Bye-Law—viz., that they give notice of their desire to receive such copies upon their manuscript before sending it to the Editor. Mention should also be made as to whether the Discussion is to be included in the reprint.

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The meetings of the London Section will be held on the first Monday in each month.

SESSION 1886-87.

Prospective Arrangements.

Jan. 3.—Mr. Watson Smith, "On the Explosive, 'Kinetite.'"
" Mr. J. W. B. Mumford, "Some Notes on Grinding and Separating Hard Substances."
Feb. 7.—Mr. W. Jago, "On Fermentation in its relation to Bread Making."
" Mr. J. Maclear, "A New Method of Elevating Liquids, especially applicable to Acids."
" Mr. C. Napier Blake, "Notes on the Stassfurt Industries."

Notices of Meetings and Papers will be found in the Scientific Journals.

Notices of papers and communications to be made to the Local Secretary.

Meeting held December 6, 1886.

THE PRESIDENT IN THE CHAIR.

ON THE MANUFACTURE OF HYDRATE OF STRONTIUM.

BY E. F. TRACHSEL.

HYDRATE OF STRONTIUM has only been manufactured in quantities during the last few years, the demand for it having sprung up through its use in the making and refining of beet-root sugar, and in the extraction

of crystallised sugar from molasses. Its advantage in the manufacture of sugar from the beet is derived from the fact that it is possible by its usage to obtain a pure white sugar direct from the beetroot, whilst in refining beetroot sugar it has been found to be far superior to lime. As for the extraction of crystallised sugar from molasses, lime alone is not sufficient to separate the crystallisable sugar from the uncrystallisable sugar and the various salts contained in the molasses, unless alcohol be used in conjunction with the lime.

Oxide or hydrate of strontium, on the contrary, effects this separation without the aid of alcohol, and it is here that its principal advantage is found. It is the tendency of oxide of strontium or its compounds with water—viz., monohydrate of strontium and hydrate of strontium—to combine with sugar by forming saccharates easily decomposed by carbonic acid, which renders it useful for the purposes mentioned.

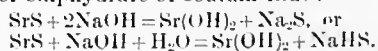
It is not my aim to give a full and exhaustive account of the manufacture of hydrate of strontium in all its details, but to put before you a general view of the subject, supported by the description of some of the processes used. The minerals at our disposal for the manufacture of hydrate of strontium are: The native carbonate of strontium, or strontianite, found chiefly in Westphalia; and the native sulphate of strontium, or celestine, the chief supplies of which are in Sicily and in Gloucestershire. The native carbonate of strontium is converted into oxide by being burnt in kilns similar to lime-kilns, care being taken to raise the temperature of the charge as high as possible, the carbonate of strontium parting with its carbonic acid with much more difficulty than carbonate of calcium does. The resulting oxide of strontium is dissolved in boiling water, the solution clarified and allowed to crystallise, when hydrate of strontium crystallises out. The manufacture of hydrate of strontium from the sulphate is of a more complicated nature, and has been attempted in different ways. One process consists in boiling the finely-powdered mineral with a solution of carbonate of sodium, when carbonate of strontium and sulphate of sodium are formed. The carbonate of strontium is then burned as before described, being mostly made into bricks with the addition of sawdust. The sulphate of sodium can be reconverted into carbonate by the Leblanc process.

Another process consists in furnacing together a mixture of sulphate of strontium and carbonate of sodium, with the production of carbonate of strontium and sulphate of sodium.

In a third process, carbonate of ammonium is used to convert the sulphate of strontium into carbonate, the conversion being accomplished in closed vessels provided with a stirring apparatus. All these processes, however, are indirect, inasmuch as they only yield carbonate of strontium, which has to undergo the operation of calcining in order to turn it into oxide of strontium. I have therefore devised and patented the following process, which does away with this disadvantage, and which, provided it is carried out in a rational manner, and with the aid of the improved apparatus now at our disposal in the domain of manufacturing chemistry, bids fair to supersede the indirect methods previously mentioned.

In order to give you a clear view of the process, it might be well to put before you the reactions on which it is based.

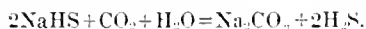
1. Sulphide of strontium solution when treated with caustic soda yields hydrate of strontium and sulphide or sulphydrate of sodium thus:—



It will be seen that the second formula is most advan-

tageous, as it used only half the quantity of soda, and it is this the proportion adopted by me.

2. Sulphydrate of sodium (as also sulphide of sodium) is converted into carbonate by treatment with carbonic acid, sulphuretted hydrogen being given off—



3. Carbonate of sodium treated by caustic lime yields caustic soda and carbonate of lime, the presence of sulphydrate of sodium in the liquor, if any, not interfering with the reaction.

We have here all the elements for a complete and continuous process, the carrying out of which I will now endeavour to describe. The sulphate of strontium as it comes from the mine is passed through a crushing apparatus (fluted rollers, disintegrator, or such like), preferably mixed with the necessary quantity of coal, which I found best as 7cwt. of coal to 20cwt. of sulphate. The mixing of the coal beforehand ensures a more uniform mixture of the two materials. After passing the crushing apparatus, the mixture of sulphate of strontium and coal is calcined in a furnace (either a so-called plus-pressure furnace or a revolving furnace), when the sulphate of strontium gives off its oxygen to the coal and is converted into sulphide of strontium, the conversion taking from three to four hours, according to the heat attained in the furnace, the fineness of the material, the character of the coal, and divers other circumstances. After reduction the mixture is carried to the lixiviators, which are of different designs, the following arrangement being one of the simplest. A round or square vat made of boiler plate is provided, at the distance of about 6in. from the bottom, with a removable grating of iron bars: on this grating a filter is spread, which can consist of sugar bags. Fragments of brick or other suitable material are placed on the top of this filter, to protect it from the action of the red-hot charge drawn from the furnace. In the middle of the grating a cast-iron pipe is fixed in an upright position, passing through the grating but not quite touching the bottom of the vat, and bearing on the top a flat or umbrella-shaped plate, between which and the pipe an interstice is left for the escape of the liquor which is forced up by the steam entering through a steam pipe placed in the centre of the cast-iron pipe at the bottom of the vat, over which it projects several inches.

In these lixiviators the charges of sulphide of strontium, as they come from the furnace, are covered with boiling water or weak liquor from a former operation, as the case may be, and the steam is turned on, which not only keeps the liquor boiling but also circulates it energetically, the steam forcing the liquor, which has percolated through the false bottom, upwards in the cast-iron pipe, when it falls back upon the charge. After the liquor has attained a strength of 24° Twaddle it is allowed to settle and then run off to the crystallising tanks, where it is treated with a strong solution of caustic soda. This causes the greatest part of the hydrate of strontium to fall down at once, another quantity crystallising out on cooling. The mother-liquor, which consists chiefly of sulphydrate of sodium, is drained off the crystals and run into the evaporating pans, where it is concentrated to about 30° Twaddle, and then run into other crystallising tanks. In these tanks the mother-liquor is allowed to cool, whereby it deposits practically all the hydrate of strontium still held in solution. After cooling, the mother-liquor is transferred to the carbonators, in which carbonic acid gas of as great a strength and purity as possible is forced through it.

The crystals of hydrate of strontium are dried and washed in hydro-extractors and twice recrystallised,

which makes them ready for packing. This repeated crystallising is connected with a serious loss, caused chiefly by the formation of carbonate of strontium during the dissolving and the crystallising in the tanks, and I have succeeded in making one crystallisation sufficient to get pure crystals by the following treatment. The impure hydrate of strontium, after being once dried and washed, is thrown into a muffle furnace, where it is gently heated and stirred about in the meantime. During this operation part of the water of crystallisation is driven off, the double sulphide of iron, which chiefly causes the discolouration of the crystals, is oxidised, and any sulphide of strontium retained in the crystals is changed into sulphite, sulphate, and hyposulphite, whilst a small part of the hydrate is converted into carbonate, through the action of the carbonic acid of the atmosphere. This carbonate, together with the carbonate already contained in the crystals, is sufficient to throw down all the iron, now in the state of oxide, when the furnace product is dissolved in boiling water. The impure crystals of hydrate of strontium contain before this treatment about 37 per cent. of oxide of strontium, and I found it best to continue the heating until the mass shows a percentage of from 60 to 70 per cent. of oxide of strontium. After the furnace product is dissolved in boiling water, the solution is clarified and allowed to cool, and the crystals after going through the hydro-extractor are ready for packing. It will be seen that this simple treatment of the crystals not only dispenses with one crystallisation and the losses connected therewith, but that it also is the means of turning over the crystals in a much shorter time, which, from a manufacturer's point of view, is important. It is the means of doing in six days what otherwise would require a fortnight. I must now return to the mother-liquor of sulphydrate of sodium. Through this mother-liquor, as I have stated before a current of carbonic acid gas is forced which, acting on the sulphydrate of sodium, turns it into carbonate of sodium, whilst sulphuretted hydrogen is given off.

It has been proved by others that sulphide of sodium is decomposed by an equivalent of carbonic acid, so that I need not dwell upon this part of the process particularly. I may, however, observe that by using strong solutions of sulphydrate of sodium, as I always do, the action of the carbonic acid is so energetic that the liquor becomes quite hot, and that if the conversion is carried far enough the whole mass on cooling becomes one solid lump of carbonate of sodium.

The sulphuretted hydrogen is passed through a Claus-kiln, which contains a layer of hydrated oxide of iron or of manganese, and at the same time a small quantity of air is blown through the oxide sufficient either to turn the sulphuretted hydrogen into sulphur and water, or else into sulphurous acid and water. The operation presents no difficulty, even with dilute gases, and it is possible to recover nearly all the sulphur either in the elementary state or as sulphurous acid capable of being used for the manufacture of sulphites or of sulphuric acid. It is best to keep the carbonators warm, so as to prevent a crystallisation of carbonate of sodium in them, and when the conversion of the sulphydrate of sodium is deemed to be sufficient the liquor is run into the causticiser to be causticised by lime in the well-known manner. It is, indeed, not necessary to continue the treatment of the sulphydrate of sodium liquor until the whole of it is converted into carbonate of sodium, because, as I have mentioned before, the presence of sulphydrate of sodium in the liquors does not interfere with the causticising. The liquor, after having been causticised, is again used in the first part of the process, thus

making it possible to use the same quantity of soda over and over again, and rendering the process a continuous one by which all the sulphate of strontium is converted into hydrate of strontium.

DISCUSSION.

Mr. B. E. R. NEWLANDS : The author had said that it was impossible to remove glucose from sugar by lime alone. That was a mistake, because lime would remove every trace of glucose. He should like to hear more from the author on the rapidly developing uses of strontia. It was very interesting to see a substance like strontia, formerly regarded as of very little use, become so intimately connected with a large and important industry. It was more interesting still to sugar refiners to know that their old friend lime was being rapidly displaced not only by strontia but by another competitor, baryta. Baryta was generally regarded as "very poisonous," and strontia had been also described as "poisonous"; but with regard to the latter, he could answer for it that small animals, such as mice, could take it without any ill effects. Therefore he considered strontia as far preferable to baryta for sugar refining. Baryta, however, had recently been introduced into the Paris sugar refineries, and he expected that the public analysts here would have something to say about it before long. He had tested sugar refined by means of baryta in conjunction with phosphate of ammonia, and had found it quite easy to detect traces of baryta in sugars so manufactured. It would be very desirable that public analysts should have their attention drawn to this subject. Had the author succeeded in getting a complete reduction of his sulphate of strontium? He himself had experimented with it some years ago, and had found great difficulty in getting a reduction beyond 60 per cent. If one-third or thereabouts of the sulphate were lost in working, that would make a serious difference in the expense of the process. He would like to know also, if the process had been used commercially.

Mr. J. MACTEAR, before discussing the paper, drew the attention of the meeting to a remarkable fact in connection with strontia and baryta processes for recovering sugar from molasses. In such processes a considerable proportion of the sugar underwent a change of character, and came out of the solution in needle-shaped crystals. These needle crystals polarised 108 per cent., and this appeared to have a higher sweetening power than they really possessed. Difficulties have constantly arisen in France in estimating the sugar present in them; the sugar merchant naturally objecting to pay for 108 per cent. when he gets only 100 per cent. In the paper just read, Mr. Trachsel had described a reaction which did not actually take place. The reaction which really does take place is not between caustic soda and strontium sulphide as such, but between caustic soda and strontium sulphhydrate in a mixed solution of strontium hydrate and strontium sulphhydrate. The process described by Mr. Trachsel being based on the reaction between caustic soda and a solution of strontium sulphide, was much the same as that patented in connection with baryta by Brooman in 1863. As now proposed, the process appeared to be a very ingenious one and ought to work well. But he thought that the author should alter his statement of the decomposition so as to include the water which played a part in it, since it was an undoubted fact that directly one treated sulphide of barium or strontium with water it split up into nearly equal portions of hydrate and sulphhydrate, and that the reaction with the caustic soda was with the sulphhydrate of strontium, and not with the sulphide.

Mr. W. B. GILES said he had had some experience with the various methods of producing strontium hydrate alluded to by Mr. Trachsel. In the first place, he had tried on a large scale the decomposition of strontium sulphate by carbonate of sodium, and had found it go very well. It took very little more than an equivalent of carbonate of sodium to decompose an equivalent of finely-ground native celestine. He had also worked on a considerable scale a process for treating native strontium sulphate by carbonate of ammonium. The method consisted in passing gas liquor fresh from the tower through Bristol celestine. The carbonate of strontium thus obtained was very pure. It was intended for pyrotechnic use, and the flame it gave when converted into nitrate was far superior to that obtained by means of carbonate of sodium. He had noticed a curious fact in respect of nitrate of barium, in the manufacture of which soda had been used. He had taken a considerable quantity of that body and had recrystallised it six times successively in distilled water, and had found the last crop of crystals to contain apparently as much soda as the first. He had never seen this fact noticed; though, doubtless, the same experience had occurred to others.

Mr. SULMAN wished to ask Mr. Trachsel a few questions about his process, especially with respect to carbonating the sodium sulphhydrate liquors obtained as a by-product. The commercial success of the process would depend largely on the practicability of utilising this sodium sulphhydrate again and again in a continuous round of operations. He feared it would be found too expensive to carbonate this residual sulphhydrate by carbonic acid derived from lime-kilns. It had been attempted also to use waste gases from furnaces for the carbonation of these liquors; but the oxidation which took place was so great as to convert a large proportion of the sodium sulphhydrate into sulphate and hyposulphite. He feared, therefore, that this proportion of the sodium hyposulphite must be regarded as lost, as it could not be causticised, and that this probable loss would have a most important bearing upon the future of the process.

Mr. TRACHSEL, in reply, said that, in the first instance with respect to the comparative values of lime, baryta, or strontia processes for the extraction of sugar from molasses, he had said in his paper that the superiority of the strontia process consisted in the fact that it did not require the use of alcohol, whereas in all lime processes the use of alcohol was absolutely necessary.

Mr. B. E. R. NEWLANDS observed that that statement was right so far as the extraction of the salts was concerned, but no further.

Mr. TRACHSEL thought his argument was proved by the fact that, so far as he was aware, no lime process was in actual use which did not in some way include the use of alcohol.

Mr. B. E. R. NEWLANDS rejoined that the Steffen process did not require alcohol, and that that process was in actual work on a large scale at Cologne.

Mr. TRACHSEL replied that if such were the case it would materially affect the value of his strontia process. He had not spoken of other processes for the purification of sugar, for the simple reason that they did not appear to come within his limits. He knew that several new processes had been started recently and were, he believed, going well. It was always the case that, when a new chemical process for getting a particular result was started and succeeded well, other processes sprang up in a short time and attained the same result more or less successfully. With respect to his own process, he could say

that several manufacturers were already working it, and, as far as he knew, successfully. Someone had inquired whether the decomposition of strontium sulphate into sulphide was complete. That depended very much on the temperature of the furnace, and also on the fineness of the material treated. The specimen of sulphate handed round during the reading of this paper showed that, though the mineral as a whole was rather friable, the individual crystals were pretty hard. The rapidity and completeness of the reaction depended entirely upon the degree of fineness to which the mineral was ground.

Mr. NEWLANDS inquired to what extent the decomposition was possible?

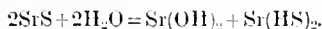
Mr. TRACHSEL replied up to about 90 per cent.

Mr. CRESSWELL asked whether a high or low temperature was preferred?

Mr. TRACHSEL replied that he preferred a high temperature.

Mr. NEWLANDS observed that he understood that coal was mixed with the sulphate, and that then a 90 per cent. reduction was got.

Mr. TRACHSEL said that was correct; and the better the coal the better were the results. The process had been used for about six months, and, from a chemical point of view, was quite successful. He was not, however, in a position to go further into details at that moment. Mr. Maclart had combated his statement of the reaction which took place between strontium sulphide and caustic soda. No doubt practically it was as Mr. Maclart had said; but chemically regarded he thought that when strontium sulphide was dissolved in water the reaction was really:



There would always be found a small quantity of hydrate in excess of the sulphhydrate, and he thought it was this small excess which gave the initial movement to the decomposition. [Some further discussion ensued upon this point, and it eventually appeared that Mr. Trachsel and Mr. Maclart were at one on the subject.] Mention had been made of a process for the decomposition of sulphate of strontium by carbonate of sodium. He knew that such a process had been tried, but believed it had been dropped because it was found impracticable to regenerate the sodium carbonate for use again. He had been asked if the decomposition of his residual sulphhydrate of sodium by carbonic acid was really profitable. He was quite aware that the decomposition of sodium sulphide by carbonic acid had been often attempted and often patented. But it had always been proposed to start from solid sulphide of sodium. Now it was practically impossible to obtain solid sulphide of sodium on a large scale. The late Mr. Weldon had tried to manufacture carbonate of sodium in this way; and his best endeavours had failed, not because of the difficulty of the decomposition, but because of the difficulty of getting the sulphide. In the strontia process that difficulty did not occur, for the sulphide of sodium was ready made to their hands. It had been suggested that flue gases might be used as the carbonating agent; but he did not think that would be profitable. The gases contained at most about 12 per cent. of carbonic acid, and lime kiln gases contained about 24 per cent. He thought it would be found of great advantage to use the latter, as the decomposition would be not only more rapid but more complete also.

Mr. NEWLANDS inquired whether, seeing that Mr. Trachsel had shown them by one of their reactions which he had formulated on the blackboard that strontic hydrate was practically insoluble in water, and strontic sulphhydrate very soluble, it would not

be practicable to run off the supernatant liquor and use the hydrate at once?

Mr. C. T. KINGZETT said that by his reference to the experiments of the late Mr. Walter Weldon, he supposed the author to mean the experiments in obtaining carbonate of soda from sulphide of sodium which he had conducted at St. Helens on Mr. Weldon's account many years ago. They had roasted salt cake with fine coal in a muffle furnace, obtaining a very impure sulphide of sodium. Carbonic anhydride was passed through a solution of this sodium sulphide in water, and the result was that they obtained about 90 per cent. of sodium hyposulphite, and only about 10 per cent. of sodium carbonate. This result was probably due partly to the unavoidable admission of air into the muffle, and partly to the presence of air with the carbonic anhydride.

Mr. TRACHSEL explained that even if hyposulphite were present with the soda used to decompose the strontium sulphide, it would make no difference in his process, since a double decomposition would take place—viz., $\text{SrS} + \text{Na}_2\text{S}_2\text{O}_3 = \text{Na}_2\text{S} + \text{SrS}_2\text{O}_3$, which latter would immediately decompose into $\text{SrSO}_3 + \text{S}$, therefore any hyposulphite present or formed would be rendered harmless.

NOTE ON THE VOLUMETRIC ESTIMATION OF NITROUS ACID.

BY A. G. GREEN AND F. EVERSHED.

IN the *Chemical News*, vol. xlix. p. 173, A. G. Green and S. Rideal describe a process for the volumetric estimation of nitrous acid by means of aniline. Although the results obtained by this process are very accurate, it is somewhat too tedious, and requires too much care in manipulation to be generally available for technical purposes. In the modification now to be described, we have greatly simplified and shortened the operation by substituting normal for decinormal solutions. The employment of the diazo-reaction for the estimation of nitrous acid instead of an oxidation process has the great advantage, apart from its accuracy and convenience, that most oxidisable substances which may also be present are not affected. In fact by this means nitrites may be determined under conditions which would entirely preclude an oxidation method.

The normal aniline solution contains 93grms. of pure aniline (freed from water by redistillation), and about 450cc. of hydrochloric acid in 1 litre. Of this solution, 25cc. is placed in a small stoppered bottle, together with a little ice. The solution of the nitrite (about normal) is run in from a burette, with continual agitation. From time to time a drop is taken from the bottle and mixed on a white slab or dish with a drop of a solution of potassium iodide and starch. The immediate production of a blue colour indicates the presence of nitrous acid. When this point is reached, the bottle, with stopper replaced, is left to stand, surrounded with ice. If after some minutes another testing shows that the nitrous acid has been taken up, another drop is added from the burette, and so on, until there is an excess after the solution has stood for an hour. In testing with the starch solution, account must only be taken of the colour which is produced *at once*, as, on standing, the drop almost always becomes coloured even when no excess of nitrous acid is present. By the quantity of the nitrite solution used, omitting the last drop, its value in HNO_2 or NaNO_2 is indicated.

We have not found time to test the process directly, but we have compared its results with those given by a slight modification of the improved

permanganate process described by Kinnicutt and Nef in the *American Chemical Journal*, vol. v. p. 388, and reprinted in the *Chemical News*, vol. xlviii. p. 274. For this purpose a portion of the same nitrite solution was diluted to one-tenth the strength, and 10cc. of this solution placed in a flask with 40cc. of water and a drop of ammonia. A considerable excess of decinormal permanganate (about 25cc.) was run in, then immediately 10cc. of pure concentrated sulphuric acid, then decinormal oxalic acid in slight excess, and lastly, permanganate, until the solution had a permanent pale pink colour, due to an excess of 0.02—0.05cc. A correction was made for this excess, and for an impurity in the sulphuric acid, which, in blank experiments, reduced about 0.1cc. of permanganate. The quantity of oxalic acid used was then deducted from the corrected quantity of permanganate, and the percentage of nitrite thence calculated. The following results were obtained by the two processes:—

SODIUM NITRITE IN STICKS SOLD AS "PURE."
PERCENTAGE OF NaNO_2 .

Aniline Process.		Permanganate Process.	
Experiment.		Experiment.	
1. 97.27		1. 97.40	
2. 97.27		2. 97.65	
3. 97.01		3. 97.60	
4. 97.09			

A SAMPLE OF COMMERCIAL SODIUM NITRITE BY
ANILINE PROCESS ONLY.

1. 95.06% NaNO_2	1. 94.86% NaNO_2
2. 94.88 "	5. 95.13 "
3. 95.05 "	6. 95.01 "

DISCUSSION.

The CHAIRMAN said the method now described by the authors appeared to him to be a very good modification of the original process for testing nitrites.

Mr. CROWDER asked whether the authors considered this method was an improvement upon the old permanganate test for vitriol in the chambers. It seemed to him to be very difficult to hit the mark with this new method of testing, whereas any boy in the laboratory could use the permanganate of potash test.

Mr. EVERSHED replied that the advantage of using the aniline test instead of the permanganate test consisted in the fact that the former was much more accurate. Permanganate of potash would oxidise other substances besides nitrites; and in many instances there might be impurities present which would cause the results to appear higher than they really were. It was of course quite possible that the permanganate test might be equally or more suitable as the aniline test for vitriol, especially if used with modifications introduced by Messrs. Kynaston and Rideal. But he thought the ordinary permanganate test would be found to give somewhat varying results, and to be altogether unsatisfactory where accuracy was required.

Mr. J. W. LEATHER asked how long it was considered necessary to allow between adding the different portions of the nitrite from the burette, as that was a matter of importance.

Mr. EVERSHED replied that he was not aware that it mattered. So soon as the nitrite had disappeared more was added. It was often a matter of guess-work. One would get perhaps 80 or 90 per cent. of the nitrate run in, and then find a blue colour produced. He would leave it for a few minutes, and if it were not then all absorbed he would leave it again. If it stood for a considerable time—say half an-hour—and still did not give a blue colour, one might consider the thing done. He did not pretend that the test was an absolutely accurate one.

Thanks were given to the authors of all the papers for their contributions.

ERRATA.—In the November issue of this Journal, page 563, Discussion, Dr. Armstrong's remarks, in line 7 of those remarks, for "lower" read *larger*; in line 27, before the word "residuals," insert *valuable*.

Liverpool Section.

Chairman: Prof. J. Campbell Brown.

Vice-Chairman: Dr. F. Hurter.

Committee:

J. Atleek.	J. W. Kynaston.
E. G. Ballard.	E. K. Muspratt.
Ernest Bibby.	Jas. Simpson.
H. Brunner.	A. Norman Tate.
J. C. Gamble.	A. Watt.
D. Herman.	

Local Sec. and Treasurer: W. P. Thompson, 6, Lord Street, Liverpool.

Meetings will be held at the Chemical Laboratory, Brownlow Street, on Jan. 5, Feb. 2, March 2, April 6 (Annual Meeting), and May 4, and the following papers have been promised:—
Mr. James W. Westmoreland, "On the Determination of Sulphur in Pyrites."
Mr. V. C. Driffield, "On Boiler Management."
Dr. George Archbold, "On the Manufacture of Starch."
Mr. G. Watson Gray, "On the Estimation of Tin in Wolfram Ores."
Mr. A. Norman Tate, "On Melting Points."

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

A Meeting was held in the Chemical Theatre of the University College, Brownlow Street, on Wednesday evening, December 1, 1886.

PROFESSOR CAMPBELL BROWN PRESIDING.

ON HEISCH AND FOLKARD'S PYROMETERS.

BY F. HURTER, PH.D.

THE Publication Committee asked me to report upon a new pyrometer by Messrs. Heisch and Folkard, with a view to insert a notice of the instrument in our Journal.

I have had considerable experience with many varieties of pyrometers, or "high temperature thermometers," as they are now called, the old name having got into bad repute. There is hardly any phenomenon caused by increase of temperature which has not been made the basis of a pyrometer. We have great choice. We have contraction pyrometers and expansion pyrometers in great variety; we have dissociation tension and vapour tension pyrometers; optical and acoustical pyrometers; thermo electric and electric resistance pyrometers; but in spite of this choice a good pyrometer is still wanted. Those who interest themselves in pyrometers will find a valuable paper on the subject in *Dingler's Journal*, 225, 272, by Dr. Fischer, and several papers on special instruments in our Journal, vols. iii. and iv.

Dr. Fischer's conclusion is that the most practical pyrometer now known is the calorimetric pyrometer, and the best pyrometer is Siemens' electric resistance pyrometer. I quite agree with him from the scientific point of view. But from a practical working man's point of view, Siemens' electric pyrometer is too troublesome to keep in order, and vastly too expensive. It is a good instrument for an investigator; but it is very little use in works. A new modification of it has been proposed by Spohr (*Dingler's Journal*, 257, 315), who substitutes an induction coil and telephone arrangement for the voltameter or galvanometer of

Siemens' instrument; but I doubt whether the instrument so modified has any claim to being an improvement on the galvanometer arrangement. For the working man there is nothing yet but the calorimetric pyrometer, and the ordinary differential expansion instrument, unless Mr. Murrie's thermometers prove satisfactory.

The calorimetric pyrometer—the only one at present known which will give satisfactory results at all temperatures—has, I believe, been first described in this country as a technical instrument by Mr. Wilson, of St. Helens. One form of the instrument is also sold and known as Siemens' pyrometer. Another modification of it is described as Fischer's pyrometer, in the "Alkali Makers' Pocket Book." It is so well known that I refrain from describing it.

The calorimetric method requires, however, the use of tolerably extensive tables, or rather tedious calculations, if the temperature must be labelled correctly, as Professor Dittmar expresses himself—*i.e.*, if the temperature must be given in a number corresponding to one of the recognised scales.

For working purposes I have always dispensed with labelling the temperatures correctly—*i.e.*, I take no notice of the variations in the specific heat of the metal or the water into which it is plunged. I am thus enabled to make a little slide rule arrangement which saves all calculations, and thus makes the calorimetric method available for the working men, many of whom could not be trusted to make the calculation. It must, however, never be forgotten that by neglecting the variation in the specific heat, great differences arise between the real and the apparent number of degrees. At higher temperatures the results are much too high; at lower temperatures than the one for which the specific heat is the correct one, the results are much too low.

Professor Codazza proposed a method by which the troublesome calculation of the temperature with the variable specific heat of metals is avoided. The method consists in making with the same calorimeter two experiments, using two pieces of metal of different weight. Starting with the same initial temperature of the calorimeter, the final temperatures will be different, say t and t_1 , because the quantities of heat Q and Q_1 , transferred by two pieces of different weight p and p_1 , will be different, although the temperature T of the pieces of metal before being plunged into the calorimeter is the same. If c is the mean specific heat between T and ordinary temperature, we should have—

$$Q = c p (T - t) \text{ and } Q_1 = c p_1 (T - t_1)$$

By elimination of c we obtain—

$$T = \frac{Q p_1 t_1 - Q_1 p t}{Q p_1 - Q_1 p}$$

$$Q p_1 - Q_1 p.$$

The method is ingenious, but in my hands has not given satisfactory results.

As trustworthy as the results are, as inconvenient is the calorimetric method. In the first place, observations can only be made at intervals of at least thirty minutes. An iron cylinder of 50 grms. takes nearly half-an-hour to assume the temperature of the furnace. In large apparatus, where changes of temperature within that period are not noticeable, this is of no consequence, but in very small apparatus, with only a few tons of mass, this length of time becomes an objection when the operation to be carried out in the apparatus is at all delicate. Moreover, the frequent calorimetric determination of the temperature becomes a tedious business, and makes one long for a self-indicating instrument where a temperature has to be kept within narrow limits. I consequently use, in conjunction with the calorimetric method, an ordi-

nary expansion pyrometer, made of metallic rods, on the Gauntlet principle. We often extemporise these arrangements, using part of the apparatus itself. For instance, when ascertaining the temperature of superheated steam, we use a straight length of the steam pipe itself as the expanding metal.

Much has been said against these ordinary metal pyrometers. They have been expected to do too much. A range beyond red heat is usually marked on their dial, leading to the belief that they may be used to any degree. They are utterly worthless while new; they are ruined by any temperature close to visible red heat; but up to 900° F. they are not bad. My experience has shown me that newly-drawn metal rods rapidly change, undergo some kind of annealing, but after some time give tolerably uniform results. But every time they are cooled they require resetting. It is the cooling which spoils them.

By means of these two kinds of pyrometers I have hitherto managed to solve all technical problems requiring a knowledge of temperature, the expansion

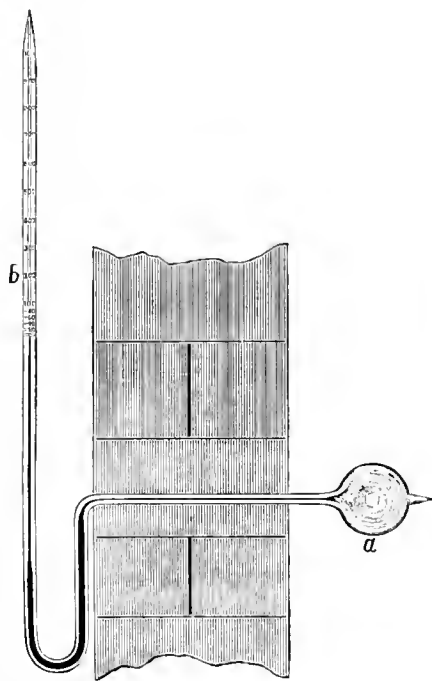


FIG. 1.—HEISCH AND FOLKARD'S AIR PYROMETER.

pyrometer indicating constantly the direction of the change and the calorimetric pyrometer giving a reliable record of the actual temperature.

It would be a great boon if we had a pyrometer which would combine both these properties—*i.e.*, which would indicate correctly and continuously.

It is generally accepted that the air pyrometer is the only one which would do that with certainty. Many forms of air pyrometers have consequently been constructed, but not any of them have been able to find their way into workshops. Dr. Fischer, who mentions most of these air pyrometers, came to the conclusion that for technical purposes air pyrometers are generally inapplicable.

I also have designed and tried various forms of air pyrometers, but have abandoned them all. I use one in the laboratory occasionally of similar form to that described in our Journal, vol. iv. 45, by Mr. Beilby. For checking other pyrometers I simply

insert into the air-bath or oil-bath in which the pyrometer is to be tried a glass tube sealed at one end, drawn out at the other. When the temperature has become constant I seal up the capillary end of the glass tube, note the barometer, open under mercury, and ascertain thus the volume of air left in the tube. The rest is a simple calculation. But for works' purposes I had to abandon air pyrometers.

I looked with sceptical eyes on the new air pyrometer of Messrs. Heisch and Folkard, of Brentford. It consists of a bulb *a* (see Fig. 1) which contains rarefied air, and which, by means of a fine capillary, is connected to a mercurial vacuum gauge *b*. (At a temperature of 40° F., at which the bulb of the instrument on the table was sealed, the vacuum was 94mm. of mercury). When the bulb *a* is heated the rarefied air begins to exert a greater pressure and the mercury rises in *b*. The space above the mercury is as perfect a vacuum as can be made. The novelty and the great feature of this instrument is the use of rarefied air and a vacuum gauge. By these means Messrs. Heisch and Folkard have succeeded in reducing the dimensions of the gauges to reasonable limits. In

lation of the degrees is tedious, and is not worth the trouble. Mr. Folkard therefore constructed another instrument on similar principles, but in which the air is always at constant volume. This instrument (Fig. 2) is also before you. Mr. Folkard lent it me for the occasion. He calls it his standard thermometer. The method of keeping the air at constant volume is simply this: The same length of column of mercury is always supported by the pressure of the air in the bulb, but this column is inclined, and as the temperature increases, the mercury is not allowed to move upwards, the inclination of the pressure tube is altered so as to keep the mercury exactly at the same point. The pressure exerted by the mercury is proportional to the length of the column multiplied by the sine of the angle of inclination. By means of a movable vertical scale *c* the length of a vertical column of mercury which would exert the same pressure as the inclined one can be readily read off; thus angular measure and references to trigonometrical tables are avoided. The instrument is simple enough, but would not answer as a practical pyrometer. By means of it the

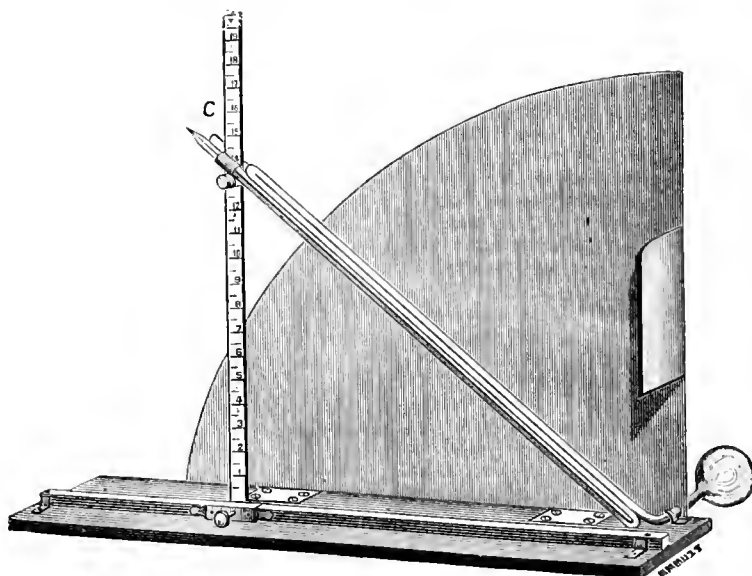


FIG. 2.—HEISCH AND FOLKARD'S STANDARD THERMOMETER.

the instrument before you, the whole range from 0° to 1000° F. is only 17 centimeters long, and as you see the degrees are equally divided, the sensitiveness is equal throughout the range. Of course where a larger degree is required it is only necessary to make the gauge longer and not to exhaust the bulb so much. But I find that for all my requirements, a range from 16 to 20mm. per 100° F. is sufficient, and this is obtained with a vacuum of from 90 to 110mm. at ordinary temperature. The theory of this instrument has been published, I believe, in 1875, by Pfandner as a special case of differential thermometers, but not having access to the journal in which his paper is published, I do not know whether Pfandner really made any practical proposal in this direction. I have found no indication of such a vacuum pyrometer elsewhere.

If the air in the bulb remained at constant volume, which it does not, the degrees of the instrument would be theoretically all equal, but as the air in displacing mercury from the gauge expands, the degrees become somewhat smaller theoretically for the higher temperatures than for the lower ones. The exact calcu-

technical instrument can be graduated. In the first instrument I made I found that the graduations so obtained differed from the graduations calculated on the assumption that the air was at constant volume so little, that I was induced to calculate dimensions of an instrument such that the deviations should remain less than, or amount at the outside to, two per cent., so that by substituting the calculated scale for the real scale I should commit no greater error than 20° F. in 1000° F. I find that with a pressure tube of 2mm. bore and a bulb of 30 to 40cc. capacity, with a vacuum of 100mm. mercury, the deviation is less than two per cent. provided that all noxious space, excepting that of a very fine capillary connecting tube, is avoided. I thus succeeded in making the instrument so that I can calculate the scale, which is readily done by the ordinary formula:—

$$\frac{Pt}{Po} = \frac{275 + t}{275}$$

where *Pt* is the pressure corresponding to temperature *t* in Centigrade, *Po* the pressure at zero and $\frac{1}{275}$

the coefficient of expansion of air in glass. There are various little errors, but the whole of them may, for technical purposes, be neglected. Whether a temperature is labelled 980° or 1000° is, for technical purposes, immaterial.

Now, as to the performances of this instrument. I had one which I heated at intervals of several days for some hours to 500° F., simply to ascertain whether it would change its zero. Within six months it has not changed visibly. Then the next question was, At what temperature will the glass bulb collapse? Clearly a glass tube will not stand a temperature much higher than 1000° F. I have had one of these instruments made of ordinary test tube glass at 900° F. for 24 hours; it has not collapsed and has not changed its zero. I consider that Messrs. Heisch and Folkard have provided us with an instrument which is applicable in many cases, and which, if properly made, is reliable and labels temperatures tolerably accurately, even if a calculated scale is adopted instead of empirical graduations. For scientific purposes I would prefer an instrument with open gauge, but for works the very small length of the gauge is its recommendation. The instrument is, of course, fragile and rather difficult to transport, but it is not expensive, and should not cost many shillings. But for higher temperatures we shall still have to use the calorimetric method, unless Messrs. Heisch and Folkard see their way to substitute a different material for the glass bulb, which, I am afraid, they will find very difficult.

Manchester Section.

Chairman: Sir H. E. Roscoe, M.P.

Vice-Chairman: I. Levinstein.

Committee:

Dr. Bowman.
R. F. Carpenter.
C. Estcourt.
H. Grimshaw.
Peter Hart.
Dr. Gerland.

C. Schorlemmer.
Dr. Schunck.
Dr. Watson.
Wm. Thomson.
L. Siebold.
Dr. Hewitt.

Local Secretary:

J. Carter-Bell, Bankfield, The Cliff, Higher Broughton, Manchester.

Notices of papers and communications for the meetings to be sent to the Local Secretary.

*Chemical Club Rooms, Victoria Buildings, Tuesday,
December 7, 1886.*

IVAN LEVINSTEIN, ESQ., IN THE CHAIR.

THE MANCHESTER JUBILEE EXHIBITION.

THE CHAIRMAN, referring to Sir Henry Roscoe's remarks at the opening meeting, with regard to the forthcoming Jubilee Exhibition in Manchester, and to the section of the exhibition in which the members are more particularly interested—viz., that devoted to chemical and allied industries, said that all the large amount of space kindly allotted to this section by the Executive Committee had been applied for. Indeed it had been found impossible to entertain all the applications that had been received. It might be expected, therefore, that that section would not be behind any other section in the importance and interest of its exhibits. Marvellous progress had been made in the erection of the elegant structure which is intended for the exhibition. On looking carefully over the ground and the drawings he was strongly impressed with the belief that it would be a very great pity, after the successful termination of the exhibition, to break up these commodious and well-constructed

buildings, which appeared so admirably adapted for conversion into a great technical institute in conjunction with a technical museum and dépôt for samples and patterns of goods required by foreign nations. A comprehensive and thoroughly-well equipped technical institute, supported by a first-class teaching staff, and guided by a chief of real attainments, experience, and high position in science, would be, in his opinion, of the greatest value to the many branches of industry established in this neighbourhood. The utilisation of the exhibition buildings for such a purpose as that which he suggested would confer everlasting fame on the Jubilee Exhibition of Manchester.

ON THE DEVELOPMENT OF BLACK SPOTS ON PAPER IN WHICH WOOLLEN GOODS HAD BEEN WRAPPED.

BY WILLIAM THOMSON, F.R.S.E.

THE black spots in question appeared as if they had been caused by ink, most of them having a perfectly definite outline; there were some, however, round which there appeared a faint brownish tinge. Some of the spots were cut out and macerated in water for comparison with an equal weight of unstained paper which was similarly treated. The black spots gave a much more distinct acid reaction than the unstained, and this reaction was due to sulphuric acid. This led me to suppose that the black spots might be due to free sulphuric acid which had got spirted on to the paper, and which on drying had charred it. Experiments were made with sulphuric acid of different strengths, put in a similar manner on the same paper and heated, but the black spots thus formed were very different in character from those in question. They had a much more strongly acid reaction to litmus paper, besides being different in appearance, and in their behaviour towards reagents.

On treating one of the spots in question with nitric acid, the black colour disappeared, giving place to a greenish colour, and on adding ammonia a deep blue was at once developed. Some of the spots were cut out and an equivalent quantity of the unstained paper taken for comparison; both were burned to ash, which was then dissolved and tested: a large quantity of copper was found in the stained parts, whilst none was contained in the unstained portions.

The questions now arose, How did the particles of copper oxide which originally existed in the paper get there? and then, How did that greenish oxide become converted into a black compound? It was evident at first that the paper was free from black spots, but when some woollen goods were wrapped in them the black spots gradually developed. I found, on putting a piece of bibulous paper containing lead acetate among the woollen materials, that the paper soon became brownish-coloured and ultimately black by the sulphuretted hydrogen which was liberated from the wool, and it seems clear that the objectionable smell which new woollen materials possess is due in some degree, if not entirely, to the liberation from them of sulphuretted hydrogen or of some volatile organic sulphides. Possibly the use of sulphurous acid in the bleaching process tends to the formation of some sulphur compounds, which slowly decompose, yielding sulphuretted hydrogen, or somewhat similar substances.

The particles of copper oxide have evidently come from the oxidation of some brass buttons which had been left on some of the rags introduced into the rag machine during the manufacture of the paper, as it was only a comparatively small portion of this paper which was thus affected. The pale greenish particles of copper oxide were not easily seen at first, but

when the sulphuretted hydrogen from the woollen goods came in contact with the copper oxide, it formed the sulphide of copper, and so brought into existence these mysterious black spots. Part of the sulphuretted hydrogen thus arrested was evidently converted into sulphuric acid, which gave the acid reaction to litmus paper.

DISCUSSION.

Mr. H. GRIMSHAW: I should like to ask Mr. Thomson how he accounts for the copper spots in the paper?

Mr. W. THOMSON: The only reason than can be given for the copper spots being on the paper, is that some of the rags which had been used had had some brass buttons on them, and in the process of manufacturing the paper the surfaces of the metal oxidised and produced oxide of copper, which got mixed with the paper, and it was not observed until the paper was used for wrapping up the woollen goods, when the sulphuretted hydrogen came in contact with it, converting the oxide into sulphide of copper, and so developed the spots.

CHLORIDE OF SULPHUR: ITS PROPERTIES AND REACTIONS, WITH ESPECIAL REFERENCE TO ITS USE AS A VULCANISER, AND ITS ANALYSIS.

BY CHAS. A. FAWSITT.

THE discovery of Parkes, in 1846, that indiarubber could be vulcanised by merely immersing it for a few seconds in a solution of chloride of sulphur in bisulphide of carbon, gave birth to the manufacture of chloride of sulphur. Although its consumption is small it is nevertheless an article of great importance to the indiarubber manufacturer, who in very many instances has little idea of its properties. For this reason I thought that a few notes which I had gathered might be of interest to this Section, in which the rubber industry is so strongly represented.

I shall (1.) briefly describe the different chlorides of sulphur supposed to exist, and the commercial varieties.

(2.) Show that their decomposition by water is not as simple as is generally supposed.

(3.) Mention the principal uses of chloride of sulphur, with special reference to its employment as a vulcanising agent.

(4.) Describe a method for the estimation of the sulphur and chlorine in the chlorides of sulphur.

Firstly, There is evidence to show that three distinct chlorides exist: Sulphur monochloride, S_2Cl_2 ; sulphur dichloride, SCl_2 ; sulphur tetrachloride, SCl_4 . It is the first and second that we have to deal with more particularly to-night.

Sulphur monochloride, S_2Cl_2 , is a yellow liquid, having a sp. gr. 1.7044 at 0° C., and 1.6822 at 15.5° C., boiling at 136–137° C. at 755mm. I arrived at these numbers after bestowing great care on the samples taken, and they are the mean of several determinations. This chloride is a well-defined stable compound.

Sulphur dichloride, SCl_2 , is a dark red, unstable compound existing in the pure state only at temperatures below 10° C. It has, according to Dumas, sp. gr. 1.62, but no constant boiling point.

In the *Phil. Mag.* 1871, 309, Thorpe and Dalzell state that a dark red liquid, supposed to be a mixture of S_2Cl_2 and SCl_2 , is obtained by passing chlorine into the monochloride, and which on heating begins to boil at 64° C., but that the temperature gradually rises until it reaches 136° C., where it remains stationary. I repeated this experiment and found

that by heating the flask in an oil-bath cautiously the liquid began to boil at 49° C., and gave off 10 per cent of a distillate under 64° C. A naked flame causes more rapid dissociation. Sulphur tetrachloride, SCl_4 , exists only at 22° C., and its properties have not been well determined.

Perhaps some of you may have noticed in a patent taken out by Parkes, in 1846, that mention is made of solid chloride of sulphur; now, as no solid chloride of sulphur is known to exist, I think the substance referred to must have been oxy-tetrachloride of sulphur, $S_2O_3Cl_4$, which no doubt, with the imperfect apparatus in use at that time for the manufacture of chloride of sulphur, would be produced in considerable quantity.

In commerce, the term "chloride of sulphur" comprehends all the kinds usually sold, and samples of which you have before you. The only difference you will notice on looking at them is one of colour, which varies from pale yellow to dark red. We will now inquire as to the difference in their composition and properties. Nos. 1, 2, 3—i.e., the light coloured varieties—have approximately the same properties and composition; they differ in colour slightly, and this is accounted for by their different modes of preparation. The following are their specific gravities referred to water at 15.5° C.:

No. 1 = 1.6820
No. 2 = 1.6826
No. 3 = 1.6816

The boiling points vary very little from one another:

No. 1 = 136–137° C.
No. 2 = 136–137°
No. 3 = 135–137°

Below you have a boiling point determination in full of No. 2, which will show you how little the temperature varies, and serve as a comparison for that of the dark varieties (100cc. taken; first drop 132° C.):—

10cc. thermometer in vapour	135° C. ..	in liquid	136.5° C.
20	136	..	137.0
30	136.5	..	137.5
40	136.5	..	138.0
50	136.5	..	138.0
60	137.0	..	139.5
70	137.0	..	—
80	137.0	..	—
90	137.5	..	—

An analysis of Nos. 1 and 3 gave the following numbers:—

	No. 1.	No. 3.	Calculated S_2Cl_2 .
Sulphur	47.33	48.30	47.41
Chlorine	52.09	51.27	52.59

You will notice that No. 3 contains 48.3 per cent. of sulphur, being 1.1 per cent. above the calculated quantity, but as this sulphur cannot be removed by distillation, it cannot be termed free sulphur. From the above numbers—i.e., those from specific gravity, boiling point, and analysis—you will see how nearly these varieties approximate to S_2Cl_2 .

Now as regards the darker varieties, Nos. 4 and 5, the numbers for specific gravity will be:—

No. 4 = 1.671 at 15.5° C.
No. 5 = 1.657 ..

Occasionally for special purposes this variety is prepared as low as 1.640.

This dark chloride has not a fixed boiling point, as you will see from the numbers below for sample 5. I select 5 as being very generally used (100cc. taken; first drop 62° C.):—

10cc. thermometer in vapour	73.5° C. ..	in liquid	84° C.
20	81.0	..	90.5
30	89.5	..	101.5
40	117.5	..	123.0
50	133.0	..	136.5
60	131.0	..	137.5
70	134.0	..	—
80	131.5	..	—
90	135.0	..	—

The thermometer in this case rises quickly until 50 per cent is distilled over, when it remains tolerably steady to the end.

You will observe that the numbers are widely different from those obtained with the yellow varieties, and we shall have to speak of them again.

An analysis of this No. 5 gives the following numbers :—

	No. 5.	Calculated SCl_2 .
Sulphur	39.67	31.07
Chlorine	60.03	68.93

The above numbers, taken in conjunction with each other, prove that this dark chloride is a mixture of S_2Cl_2 and SCl_2 , and that it has not such a definite composition as the yellow variety.

Secondly, The decomposition of chloride of sulphur with water.

As is well known, chloride of sulphur fumes strongly when exposed to the atmosphere, on account of the aqueous vapour in the latter causing its decomposition. The fumes consist chiefly of hydrochloric acid.

It is generally stated in text-books that the monochloride in contact with water decomposes according to the following equation :—



Taking this as correct for the yellow chloride, it struck me that in the case of the dark variety more SO_2 would be produced, and if such were the case it would be less suitable for vulcanising, as the SO_2 produced would oxidise gradually to H_2SO_4 , and this would be objectionable. I tested the idea by decomposing a known weight of both the yellow No. 2 and the red No. 5, with water, and sought to estimate the SO_2 produced with standard iodine solution, but failed owing to the difficulty experienced in catching the end point of the reaction. I eventually placed the matter into the hands of Professor Dittmar, and he, after having tried the iodine method, and failed, for the same reason as I had done previously, devised the following, which he says worked exceedingly well :—

A known weight of chloride was, together with a quantity of cold boiled-out water, placed in a tubulated retort connected with an inverted condenser, which was joined at the other end to an absorption apparatus containing a solution of permanganate of potash. The whole apparatus was filled before starting with CO_2 , and a slow stream of the same gas passed through the apparatus whilst the experiment lasted. After the chloride had stood for some time in contact with the water, heat was applied to the retort, and the SO_2 formed passed through the condenser into the absorption apparatus, where it was oxidised to H_2SO_4 , and finally precipitated and weighed as BaSO_4 .

The solution remaining in the retort was tested for H_2SO_4 , and, on giving a positive result, the H_2SO_4 was determined.

I was astonished to find that there was slightly more SO_2 produced in the case of the yellow than with the dark chloride, and the results were as follows :

Yellow = 3.74 per cent. sulphur given off as SO_2
Red = 3.43 " " " "

You will note that the above equation demands much more. Another fact was brought to light—viz., that in the case of yellow chloride much less H_2SO_4 was produced in the decomposition than in that of the dark. The numbers are as follows :—

Yellow = 2.08 per cent. sulphur given off as H_2SO_4
Red = 9.31 " " " "

No doubt by varying the proportion of water to chloride, and also the temperature, this result would be slightly altered, but it is of the utmost importance for a rubber manufacturer to bear in mind, as whenever moisture is presented to chloride of sulphur,

either in rubber or prepared cloth, etc., a reaction analogous to this must take place, and must have a damaging effect, especially in the case of the dark variety.

There is evidence which points to the formation of other sulphur acids in this decomposition, especially at ordinary temperatures. For instance, H_2S is always produced in small quantity, and if, after allowing the aqueous mixture to stand, you draw off a small quantity and add a little NaHO solution, you get a large precipitate of sulphur, which, taken in conjunction with the evolution of H_2S , indicates, I should say, tetrathionic or pentathionic acids.

Thirdly, The uses of chloride of sulphur, with special reference to its employment as a vulcanising agent.

Its two principal uses are for the vulcanisation of indiarubber, and the manufacture of indiarubber substitute. As is well known, when rubber is dipped into a solution of chloride of sulphur in bisulphide of carbon, it is vulcanised by a small quantity of sulphur replacing hydrogen. The evolution of hydrogen can be plainly seen by making the chloride solution strong.

Now, suppose we take the different commercial varieties of chloride of sulphur, and proceed to vulcanise in precisely the same manner, shall we get the same results ; and, if not, wherein lies the difference ?

There are two processes in which chloride of sulphur is used as the vulcanising agent—viz., the wet process and the vapour process.

The Wet Process consists in passing through or dipping into a solution of chloride of sulphur, in bisulphide of carbon or petroleum spirit, rubber goods of various kinds ; and in order to obtain some idea as to the relative merits of the different kinds of chloride, I procured some "cut sheet" of fine quality, and proceeded in the first instance to determine the amount of sulphur retained by rubber when the different kinds of varying strengths of solution were used.

For the trials I selected Nos. 1 and 5, and also distilled the more volatile portion off a sample of No. 5 in order to see what effect a chloride having an approximate composition to SCl_2 would have, only collecting the portion which came over under 64°C .

The following was my method of procedure. The pieces of cut sheet were warmed so as to free them from moisture, and were then dipped into a carefully prepared solution of one or other of the chlorides in bisulphide of carbon, the duration of the immersion being in each case 15 seconds. After taking out of this solution they were, with one exception, twice in succession immediately plunged into pure bisulphide of carbon, so as to remove the chloride which was on the surface. They were finally dried in an air-bath at 60 – 65°C . (140 – 150°F).

The experiments were conducted with great care to ensure uniform results. You have the results in Table I. on next page.

The rubber contained 0.06 per cent. of sulphur. These results show that chlorides containing a greater proportion of volatile constituents act more quickly on the rubber—i.e., for equal strengths and time they give up a larger per cent. of sulphur to the rubber. Again, by noting the numbers for 1 and 2 we see that the act of washing after having treated with chloride removes the excess of the latter from the surface, which must have a beneficial effect in practice, as it will prevent hardening. Again, by using 1 to 30 there is roughly 1.75 times as much sulphur retained as when 1 to 60 is taken.

I will now pass round a few samples in order that you may compare the effect of the different varieties.

For these trials Nos. 1, 3, 5, and the volatile portion distilled from 5 were used. (See Table II.)

These samples (see Table II.) show on examination that the yellow chloride acts quite differently from the dark; there is no tendency with the former to harden the rubber, even although used as strong as 1 to 15, whilst with the latter 1 to 60 has such a tendency, and renders the rubber inelastic.

For equal per cent. of sulphur—*i.e.*, 1 in 60 dark, Nos. 7 and 8, and 1 in 30 light, 10–13, you will notice that the former has a damaging effect, whilst in the case of the latter the rubber is almost completely vulcanised.

with the least colour has the least damaging effect on the rubber.

There is another point in connection with the use of chloride of sulphur in the wet process which I should like to mention.

When bisulphide of carbon evaporates in the air it produces cold and condenses the moisture in the atmosphere, and this is eventually left as water when the bisulphide has all evaporated; whilst, if the evaporation be conducted in a close vessel, not a trace of water would remain.

This has an important bearing on the use of chloride of sulphur in bisulphide of carbon for vulcanising

TABLE I.

No. Expt.	Variety Chloride.	Proportions used by Volume.		Time Dipped.	After Treatment.	Per Cent. Sulphur Retained.	
		Chloride.	Bisulphide.			1 in 60.	1 in 30.
1	Light	1	60	15secs.	Washed twice Bisulphide	0'461	—
2	"	1	60	15 "	Not washed	0'921	—
3	"	1	30	15 "	Washed twice Bisulphide	—	0'791
4	Dark	1	60	15 "	" " "	0'785	—
5	"	1	30	15 "	" " "	—	1'461
6	Volatile	1	60	15 "	" " "	1'141	—
7	"	1	30	15 "	" " "	—	1'839

TABLE II.

No. Expt.	Variety Chloride.	Chloride.	Bisulphide.	Time Dipped.	After Treatment.	Remarks.
1	Light 1	1	60	3secs.	Not washed CS ₂	Soft and elastic
2	Dark 5	1	60	3 "	" " "	Not so elastic as 1
3	Light 1	1	60	15 "	Washed CS ₂	" "
4	" 1	1	60	15 "	Not washed CS ₂	" "
5	" 3	1	60	15 "	" " "	" "
6	" 3	1	60	15 "	Not " "	" "
7	Dark 5	1	60	15 "	" " "	Not as elastic as 3 or 5
8	" 5	1	60	15 "	Not " "	Tendency to harden
9	Volatile SCl ₂	1	60	15 "	Not " "	Blistered and rotten
10	Light 1	1	30	15 "	" " "	Soft and elastic
11	" 1	1	30	15 "	Not " "	" "
12	" 3	1	30	15 "	" " "	" "
13	" 3	1	30	15 "	Not " "	" "
14	Dark 5	1	30	15 "	" " "	Rotten
15	" 5	1	30	15 "	Not " "	" "
16	Light 1	1	15	15 "	" " "	Soft and elastic

In using the dark variety the action will I think be analogous to its properties shown on heating, the sulphur combined with the more volatile portion will be taken out more quickly at first than that existing as S₂Cl₂, and after the process has gone on for some time the solution will approximate closely to one of the yellow chloride.

From the above experiments taken in conjunction with amount of sulphuric acid formed, when mixed with water, I should conclude that the dark chloride is not so well suited for vulcanising rubber as the yellow; in fact the chloride

prepared cloth, as the solution is often contained in open troughs. The same action must necessarily go on, and the water produced will decompose the chloride with results the reverse of beneficial.

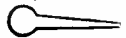
I had two cases brought under my notice lately in which the last batch of goods was damaged, and the above would, I think, account for it.

The Vapour Process.—A process for vulcanising by the vapour of chloride of sulphur was patented in 1878, by Abbott, and is I believe worked by several firms. The goods are passed through a chamber in which chloride of sulphur is evaporated, and you will readily see that to make this process work

smoothly the chloride should have a fairly constant boiling point. Now, as we have before seen, this is the case with the yellow varieties, whilst the dark kind would for this reason be unsuitable. It would be also more difficult to work, owing to the temperature having to be constantly increased to keep up a steady supply of vapour, and I should not be surprised to see the first batch of goods come out blistered.

Fourthly, a method for the analysis of chloride of sulphur.

In the analysis of chloride of sulphur a precaution to be attended to at the outset is not to expose the samples too freely to the atmosphere, as they soon change in their composition, and to avoid this in weighing the best plan is to partly fill a small thin glass

bulb with drawn out end  by warming gently and then allowing a little to be drawn in as the air cools. This is boiled, and when the bulb is deemed full of vapour the end is immersed in the liquid, which then rises and almost completely fills it; the bulb is now sealed and weighed. In the case of the dark variety care should be taken to boil out completely before filling for the last time, as if any were left in the bulb it would have a different composition to the sample.

To determine the Sulphur.—Measure into a small flask about 25cc. of strongest HNO_3 ; the bulb containing the chloride is now dropped in and broken, and to moderate the reaction the flask is kept immersed in cold water. If any undecomposed sulphur now remains, the flask is gently warmed in a slanting position and a crystal of chlorate of potash added occasionally until it is all oxidised; the contents of the flask are transferred to a basin, the excess of HNO_3 removed by evaporating in a water bath with HCl ; taken up with water, and the H_2SO_4 precipitated and weighed as BaSO_4 .

For Chlorine.—A bulb containing about 2grs. is broken under water or weak NaHO solution in a 250cc. stoppered flask, the contents well shaken, and when the decomposition is complete allowed to settle. A weighed or measured portion is transferred to a flask, and the liquid, if acid, made alkaline with Na_2CO_3 ; it is now boiled, HNO_3 added, and if any sulphur has separated out, filtered, the HCl in the filtrate is precipitated and weighed as AgCl .

DISCUSSION.

Mr. H. GRIMSHAW: I think that most indiarubber manufacturers will agree with me that the chief point about Mr. Fawsitt's paper is not that he has made any absolutely new discovery with regard to the properties of chloride of sulphur, or its action upon indiarubber, but he has given a rational explanation of the effects which the chloride of sulphur produces in its various modifications. The results which most skilled indiarubber manufacturers have observed in their experience are explained in the chemistry of the subject as placed before us by Mr. Fawsitt, and for this his paper is useful.

Mr. THOMSON: The study of the chemical composition of these chlorides, and of their actions upon indiarubber, is an important step in the right direction, in reducing to scientific accuracy and method the use of an important substance employed in the indiarubber industry, which has hitherto been used by "rule of thumb," and I think indiarubber manufacturers will be much indebted to Mr. Fawsitt for his paper. It seems interesting and remarkable that the lighter coloured samples of chloride of sulphur are more serviceable for vulcanising, and that they produce less injurious effects upon indiarubber than the darker samples, although the former contain a greater percentage of sulphur than the latter. Mr. Fawsitt pro-

poses that after the rubber goods are treated with chloride of sulphur, they should be passed through bisulphide of carbon for the purpose of removing the excess of chloride of sulphur. Perhaps he can tell us whether this would not be a somewhat objectionable proceeding, and if it would not probably at the same time remove some of the normal oily or semi-liquid constituents of the rubber. I have observed that when these substances have been removed, the rubber tends to harden afterwards by undergoing oxidation more rapidly than it would do if the oily constituents were allowed to remain in their normal proportions.

Mr. H. PHILLIPS: I have recently had a sample of chloride of sulphur to analyse of which not more than 60 per cent. distilled at 136°C . The rest seemed to be sulphur.

Mr. H. L. TERRY: As regards the composition of chloride of sulphur, these are not sufficiently understood in vulcanising, and this led to mistakes. Possibly that is the cause of the so-called "blooming." In a "bloomed" piece I have found three times as much sulphur as in a sound piece, and probably the difference in the quality of the sulphur chloride would account for this.

Mr. BELL: I had a case brought before me of some indiarubber cloth which had "bloomed," and I traced the cause of it to the adulteration of the chloride of sulphur with sulphur.

Mr. ROWLEY: I have known cases of "blooming" which have arisen from badly prepared bisulphide of carbon, and not from the chloride of sulphur at all. In all cases the bisulphide of carbon had been of foreign manufacture of a low price, and without careful preparation the same difficulty might arise with any manufacture of this article. As a matter which has engaged the attention of indiarubber manufacturers, I should like to ask whether our chemists could not discover some means by which they could deodorise in some measure the bisulphide of carbon? Thus a very great benefit would be conferred upon those who have to use it. I have known of cases of insanity produced by men inhaling these vapours.

Dr. WATSON: I should like to ask Mr. Fawsitt if he could tell us whether the bisulphide of carbon takes any part in the reaction of vulcanising? It appears very strange that the chloride of sulphur which contains the least percentage of sulphur should cause vulcanising to take place more rapidly. Perhaps the greater amount of absorption of sulphur is connected with the reaction between the chloride of sulphur and the bisulphide of carbon.

Mr. GRIMSHAW: I think it simply arises from the higher chlorides, although containing less sulphur, being more unstable, and therefore more easily decomposed when in contact with the rubber; and it does not follow that chloride with the largest amount of sulphur would necessarily part with it more readily.

Reply.

Mr. FAWSITT: As regards Mr. Thomson's remarks it is well known that indiarubber is composed of a viscous and fibrous constituent, the former of which slowly dissolves in bisulphide of carbon, ether, etc., but for the short time to which it is exposed to the bisulphide of carbon in vulcanising, it would not, I think, have an injurious effect in hardening the rubber. With reference to the damage caused by "blooming," I think this question has been already answered by Mr. Bell and Mr. Rowley. It can be caused by the chloride of sulphur containing an excess of sulphur, which can be got rid of on distillation; and also when the bisulphide contains free sulphur. In reply to Dr. Watson, the bisulphide of carbon plays no part at all in the vulcanising. It is all removed on the warming of the goods,

NOTES ON COTTON SILK OF THE GOLD COAST, CAMEROONS, AND MALABAR.

BY WATSON SMITH, F.C.S., F.I.C.,

Lecturer in Chemical Technology of the Victoria University, etc.

THIS so-called "Cotton-silk," of which I show a specimen, as well as a pod with the beautiful fibre bursting through, has been the subject of some attention lately, perhaps partly in consequence of its appearance in the Indian and Colonial Exhibition in London. It may be interesting to give a brief general account of the botanical nature and occurrence of the tree bearing this form of fibre, and then to allude to the experiments that I have tried.

The fibre-bearing plant belongs to the *Salmaal*, a genus of Malvaceæ, consisting of one or two species generally included in *Bombax*, from which they are recognised by their bell-shaped calyx being divided into three or five unequal blunt lobes; by their egg-shaped more erect petals; by the tube of the stamen being inflated or bulged out, and composed of numerous filaments in several series; and by the stigma being divided into five sharp-pointed spreading lobes. Both species are large trees, natives of tropical Asia, and have large hand shaped leaves, composed of from four to nine leaflets, and large red flowers, either solitary or several together on the naked branches. Their fruits resemble those of *Bombax*, and are filled with seeds enveloped in silky cotton. *Salmaal malabarica* or *Bombax malabarica*, the Simool-tree of India or Malabar Silk-cotton tree, attains a height of 70 or 80 feet, and has a prickly trunk and branches, leaves composed of five to seven leaflets, and clusters of flowers. The Silk-cotton of the Simool, though very beautiful, is said to be like other Silk-cottons, not adapted for spinning. It is chiefly used for stuffing cushions, and a kind of quilt or thick cloth is manufactured from it in Assam. The trunk yields a very pure gum and light porous wood, and the bark possesses emetic properties. Another species, without prickles on trunk or branches, is an inhabitant of Burmah.

I find that the tensile strength of the cotton-silk is very feeble, and hence I can quite coincide with the opinion of the botanists, already quoted. But I was led to suppose that this fibre was extremely weak after a microscopic examination, in which I viewed some of it through an immersion lens. On glancing at the fibre under the microscope, under the wet lens, and also under a dry lens, it will be seen that in the former case water will have got into the little tubes, and almost filled them, leaving bubbles of air, which can be easily seen. On glancing, in the latter case, at the dry tubes, nothing of such appearance can be seen in the tubes. Now, as these bubbles seemed so large, I concluded the fibre-walls must be correspondingly thin, and this before I made any trials of the strength. Not only did I subsequently find my conclusion confirmed, but in a recent number of the *Chemiker Zeitung*, 10, 1335, I observe some chemist has been trying a few experiments with the species found in the Cameroons, in which he also finds the tensile strength very feeble, and the fibre unsuitable for spinning. I have recently heard that attempts have been made to use this beautiful fibre, either alone or in mixture with wool or fur, for the making of hats. The result was signal failure, and a brief comparison of these two classes of fibres under the microscope will make such failure fully intelligible, when the process of felting is properly considered. Under the microscope the fibre resembles thin smooth transparent tubes without the longitudinal markings seen in the silk-fibre, and it differs from cotton by having none of the twists and irregularities of that fibre, and not being composed of

flattened, but perfectly round tubes. The appearance in the water (immersion less) is, in fact, very like what one would expect to see with the naked eye in the case of a number of bits of glass-tubing used for laboratory connections, partly immersed in the water. There are present no bamboo joint-like appearances as with flax-fibres (linen) viewed under the microscope. It is further easily distinguished from silk by merely holding a fibre to the flame, when the former at once burns with a faint flash close up to the finger, whereas a silk fibre, like one of wool, fuses to a minute head where contact with the flame has taken place; there is also more of the empyrenmatic smell peculiar to burning animal fibre. The cotton-silk fibre is very sensitive to the action of dilute acids, and it cannot be dyed with the basic aniline colours without the intervention of mordants. If some cotton-silk fibre be warmed up with a dilute solution of a basic dye, such—e.g., as methyl violet, I find the colour is very quickly taken up, whilst the dye-solution loses colour. It is possible thus to leave only a light-coloured violet solution, whilst the cotton-silk becomes coloured a very deep violet tint. I have good reason to believe, however, that this is not attraction of the colour in the true dyeing sense, but only such a kind of capillary attraction as we observe often in the case of the ground glass stopper of a bottle, for example, which latter, if filled with a solution of methyl violet, could be easily washed free from dye again with warm water, whereas the ground portion of the stopper retains it obstinately, and, as I have found sometimes, needs treatment with hot alcohol to cleanse entirely. Now, in the case of the cotton-silk tubular fibres, the wider these tubes the greater the relative area of attractive surface, and it is probable this wider surface is of a porous nature, and so exerts capillary attraction; the tubes themselves are also capillary tubes, and thus we have a greatly multiplied capillarity. In support of this theory, I must say that ordinary cotton-wool treated in a similar manner with methyl-violet solution did not show so strong a capillary attraction for the dyestuff as that shown by the cotton-silk, and the cotton tubes are certainly not nearly so wide as those of the cotton silk. By washing the cotton-silk coloured fibres with boiling water, the colour is abstracted, but I did not succeed in abstracting it all without the use of a very little soap in the water, when the fibre was quickly reduced almost to whiteness again.

I consider the cotton-silk is merely a cellulose fibre, and its silky appearance is simply due to the delicacy and thinness of its fibre walls and their consequent relatively increased transparency. In fact, in holding up a thin layer of cotton-silk, and looking at a bright gas-light through it, prismatic colours are observed just as with finely-spun glass or soap-bubble films, and this will not be seen if either cotton or silk fibres be taken and examined in like manner. The prismatic colours, I take it, are just those of thin plates in the case of cotton-silk, and are due to the extreme tenuity and transparency of the tubular walls of the fibre. The fibres are larger than those of ungnomed silk. Molisch's reagent gives, with cotton-silk, the reaction characteristic of all vegetable fibres. This test is applied as follows:—A very small quantity, about 0.01 grm. of the well-washed fibre is treated with 1 cc. of water, 2 to 3 drops of a 15 to 20 per cent. alcoholic solution of α -naphthol are added, and then an excess of concentrated sulphuric acid; on agitating, a deep violet colour is developed. In the case of a small fragment of animal fibre, such as wool or silk, merely a yellow or greenish solution is obtained.

I would strongly recommend this cotton silk as a cheap and efficient substitute for eider-down for quilts and cushions, etc.

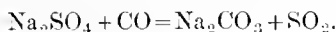
INVESTIGATION OF AN ALLEGED REACTION, ON WHICH IS BASED A RECENTLY-PATENTED PROCESS FOR MANUFACTURING CARBONATE OF SODA DIRECT FROM SULPHATE OF SODA.

BY WATSON SMITH AND W. B. HART.

A FEW months ago a patent was taken out by A. Kayser, A. B. Young, and J. Williams, of Buffalo, New York, and communicated to H. H. Lake, of this country, for the manufacture of sodium carbonate direct from the sulphate by passing a mixture of carbonic acid and carbonic oxide over the latter, maintained at a certain high temperature. In the reaction which is said to ensue, sulphur dioxide is expelled, and carbon dioxide takes its place, forming sodium carbonate. The sulphur dioxide it is proposed to pass into Hargreaves' cylinders, charged with salt, and thus form sodium sulphate, again completing the cycle of operations.

On paper, this discovery seemed to us a brilliant one, and we proceeded to endeavour to investigate more precisely the conditions under which the reaction took place. We were further impelled to publish our results obtained some months ago, by the fact that in *Dingler's Polyt. J.* 262 [7], a prominent place is accorded to an abstracted report of this invention.

The reaction that, according to the patenters, should take place, is that the carbonic oxide reduces the sulphate at the high temperature employed, and at the same expels the sulphurous acid of the resulting sulphate forming carbonate, thus :



The carbonic acid, it is said, takes no part in this reaction, but simply acts as a diluent, preventing the formation of sodium sulphide. At least one volume of carbonic acid should be present for each volume of carbonic oxide, in order that the reaction may take place. If the proportion of carbonic acid be less than this, sodium sulphide will be formed and sulphur expelled; whereas, if the proportion be greater, simply unnecessary dilution will be the result.

In our experiments, we prepared our mixture of carbonic oxide and carbonic acid by heating to decomposition oxalic acid, and collecting the gaseous mixture for use in a gas-holder. Thus we obtained equal volumes of the two gases required.

The mixture of gases was passed over the sulphate contained in a hard-glass combustion tube heated in the ordinary gas combustion furnace. The resulting gases were passed into dilute sodium hydrate. The sulphate used was the Hargreaves' salt cake, quite free from acidity. It was broken up into small bits about $\frac{1}{8}$ th in thick.

Experiment 1.—The mixture of gases was dried by sulphuric acid, and then passed over the sulphate, which was previously heated to expel moisture. The temperature used was one of low redness, and was continued for five hours. No sulphur dioxide was evolved, and the residue in the tube was perfectly neutral to litmus paper. No carbonate was found.

Experiment 2.—The mixture of equal volumes of the gases was passed in the moist state over the sulphate heated to low redness, as in *Experiment 1*, for four hours. Negative result.

Experiment 3.—The mixture of gases was now passed in the moist state over the sulphate, heated to bright redness for three hours. Sodium sulphide was produced, hydrogen sulphide evolved, and sulphur sublimed. On examination of the mass in the

tube, no carbonate was detected, although an alkaline reaction was manifested to litmus. This alkalinity was due to sodium sulphide formed in small quantity.

Experiment 4.—In this experiment the carbonic acid was used in excess, the gaseous mixture containing one-third carbonic oxide and two-thirds carbonic acid. This mixture was passed over the sulphate in presence of moisture, at a bright red heat for four hours. Here again sodium sulphide was formed, but no carbonate. Alkaline reaction merely due to sulphide.

Experiment 5.—The mixture of gases containing slight excess of carbon dioxide was passed in the dry state over the sulphate heated to bright redness for five hours. Neither sulphide nor carbonate was produced, nor was sulphur dioxide evolved. Neutral reaction of the mass in the tube. In none of the foregoing modifications was any carbonate formed. The only product was a little sodium sulphide.

In the next experiment the gases were passed separately over the sulphate.

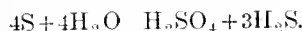
Experiment 6.—Carbonic oxide in the moist state was passed for five hours over the sulphate at a bright red heat. A certain small amount of sulphide was thus formed.

The carbonic acid was now passed over alone, and in a moist state, below a dull red heat. Hydrogen sulphide was evolved, but no carbonate was formed. The residue was alkaline, and this was no doubt due to the presence of sodium sulphide.

Experiment 7.—The first part of the previous experiment was repeated for four hours. Carbonic acid was then passed over at a low red heat, in presence of moisture, till hydrogen sulphide was no longer evolved; this continued for two days. The temperature was now increased to a bright red heat. No further hydrogen sulphide was evolved, but sulphur was deposited at the further end of the tube. No carbonate was produced, but the residue had a stronger alkaline reaction from the presence of a small amount of sodium sulphide.

In this experiment it was now clearly seen that the glass tube had been attacked, and the sodium silicate thus being formed would, of course, increase the alkalinity of the residue. The deposit of sulphur at the higher temperatures can be explained as follows :—A portion of the sulphate is partially and wholly reduced by the carbonic oxide to sulphate and sulphide respectively. The silica of the glass at the high temperature would attack the sulphide, sulphite, and also the sulphate to some extent. Sulphur dioxide and hydrogen sulphide would react to yield free sulphur.

As regards the apparently anomalous case of the second part of *Experiment 6*, we think this is to be explained as follows :—Some sulphur was contained in the tube as a residue from the first stage of *Experiment 6*; this, by the action of moisture at the lower heat, would yield hydrogen sulphide and sulphur trioxide to a small extent, which latter would react on the sodium silicate,



(It is a known fact that sulphur boiled with water will yield sulphuric acid after continued action.)

But free sulphur might be formed otherwise under certain of the conditions named, and so two further experiments were now tried.

Experiment 8.—A mixture of carbonic acid, carbonic oxide, and sulphur dioxide was passed moist through a red-hot glass tube containing pumice-stone fragments without dust. The temperature was one of bright redness. Sulphur was separated and sub-

lited to the far end of the tube. The mixture of CO and CO₂ was prepared from oxalic acid as before.

Experiment B.—The above mixture was now passed, perfectly dry, through the tube, otherwise just as in *Experiment A*. Some sulphur was also sublimed, but the quantity separated was not quite so much as in *Experiment A*.

This separation of sulphur only took place at the highest temperatures.

SUMMARY OF RESULTS.

From the foregoing it would appear—

1. No action takes place at a dull-red heat, even in presence of moisture, when carbonic oxide comes in contact in a glass tube with sodium sulphate.

2. At a bright red heat, in presence of moisture, carbonic oxide reduces sodium sulphate to sodium sulphite and sulphide.

3. At a bright red heat, moreover, the silica of the glass reacts, especially in the presence of moisture, on the sulphite and sulphide, yielding silicate, SO₂ and H₂S. These gases react to yield free sulphur.

4. From the fact that no sulphur dioxide could be detected, but only hydrogen sulphide, it may be argued that reduction by carbon monoxide tends under the circumstances named, for the most part, to carry the sulphate direct to sulphide.

5. The amount or proportion of this reduction is very small, even at a bright red heat, a temperature at which siliceous materials, like glass, commence to be attacked by sodium sulphate, sulphite and sulphide.

6. No carbonate was formed under any of the circumstances named.

7. In absence of moisture, and with carbon dioxide in slight excess over that necessary to form a volume equal to that of the carbon monoxide in the gas mixture, a bright red heat being employed, *no reduction of sulphate took place.*

8. Carbonic oxide at a bright red heat, and in presence of moisture, reduces sulphur dioxide to sulphur.

9. This reduction does not proceed quite so easily if moisture be excluded.

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The Second Meeting of the Session was held in the Rooms, 207, Bath Street, Glasgow, on Tuesday, December 7, 1886.

PROFESSOR E. J. MILLS, D.S.C., F.R.S., IN THE CHAIR.

A SYSTEM FOR THE NATURAL PURIFICATION OF WATER FOR DOMESTIC USE, AND FOR SOFTENING AND OTHERWISE TREATING WATER FOR TRADE PURPOSES.

BY W. H. HARTLAND.

BEFORE bringing to your notice this system of liquid purification, I will make a few remarks anent the practice in use, and recent proposals for purifying water on a large scale, for no system can be of interest unless it shows an advance on sand filtration and fulfils the requirements of scientific research in the elimination of germ life and other features of impure water.

Sand filtration was sufficiently criticised in a paper read before the Society, which appeared in the July issue of the Journal, describing a process of filtration invented by Dr. Gershon.

On page 416, the paper referred to reads:—"However, the result (*i.e.*, of sand filtration) in many cases was not in proportion to the cost, and the excellent report of the Rivers Pollution Commissioners in 1874 has clearly shown that the sand filters do not remove the soluble organic matter from the water: but it has been reserved to the last few years to discover something even worse than this. It is the undeniable fact that the water contains a large amount of micro-organisms, the originators of epidemic disease.

"Where sand filters are used, the water from the supply is found to have a distinct taste and odour of organic matter in a state of putrefaction in warm weather; as, for instance, in Manchester, rendering the water almost unfit for a beverage. In consequence of this we find in all the houses of the better class, special carbon filters, through which the water is again filtered. But these small filters are only for the classes which can afford to pay for them, while the poorer people have to be satisfied with the water as it issues from the sand filters containing certain quantities of suspended organic matter."

There can be little doubt these remarks accurately represent the case, and clearly show that something else is required than sand filtration, and Mr. Steiger, who read the paper referred to, lays down four conditions as necessary for a perfect system of filtration (p. 417). These conditions are—

1. The filters must purify the water "chemically and mechanically."

2. They must destroy the life of germs and micro-organisms.

3. Their cleansing must be made easy, and without causing great expense.

4. They must be more economical with regard to space and cost.

With the conditions stated no fault need be found; but this does not apply to the mode in which they profess to be obtained, or to the calculations on which the statements are based. It will be generally admitted that from a sanitary point of view the filter bed falls far short of what is required for the effective purification of water; but so far as the mechanical action of filtration is concerned, I venture to think there is no great difference between this process and the ordinary filter bed.

The first condition of purifying water "chemically and mechanically," means that the sponges and other filtering media are impregnated with tannate of iron, and the claim put forward on this account is that the pores of the sponges, etc., are hermetically sealed,

and decomposition prevented. This substance then gives rise to the claim of chemically in addition to mechanically, or the process possible to sand filtration. I do not propose inquiring further into the merits of tannate of iron for this purpose, but venture to express the opinion that the British public at least will never submit to use artificial or chemically treated water so long as a natural product can be obtained of reasonable quality; besides it would be equally impossible to fix and maintain a standard of purity by such means as it is by ordinary sand filtration.

The second condition: They must destroy germ life, etc., I need not enter into further than to say this condition in the Gershon process depends solely on the chemical and mechanical action described.

The third condition: Their cleansing, which must be easy and without causing great expense, deserves notice. For instance, the water to be treated is forced, under a pressure of from 13 to 14 feet, into the bottom of a cylinder, and so up through the sponges, etc., contained in trays, and passes out at the top—in fact, “upward filtration” through closely-packed filtering media, treated with tannate of iron; and owing to the action of this substance the passage of organic matter or microbes, etc., into the body of material is impossible, so much so that it was only found necessary to take out and wash these materials once in about two years. The cleansing out of the cylinders and contents is said to be easily accomplished by reverse currents of water; but how this operation is achieved is not very clearly shown; it is rather left to the reader to infer that the matter arrested in the cylinder bottoms, assuming that Mr. Steiger's statement is correct, and that that matter cannot enter the body of filtering media, can be effectually flushed out by gravitation alone, or without pressure at all. This assumption is opposed to all experience. Under similar circumstances, equally so is the possibility of filtering water under pressure opposed to experience; taken together these facts render it doubtful if cleansing of the cylinders would be easy or without great expense.

The fourth condition, or economy of space and cost, also requires notice, as on this feature alone I venture to think depends whatever value the Gershon process possesses over the ordinary filter bed; at the same time there can be no doubt of the abstract value of the preliminary filtration, in place of the direct action of the filter bed. It is possible the claims put forward under this head are due to mis-calculation or want of knowledge as to the average capacity of filter beds in relation to space and quantity for a given period, at all events in Great Britain.

Fig. 4, the article reads, represents a battery of preliminary filters, with six pairs of cylinders, which take up only a space of 1050 square feet, while the secondary filtration is performed in a tank of 1016 feet of surface. This plant was erected for the city of Astrachan some years ago, and corresponds to a capacity of 5000 cubic metres, or 1,120,000 gallons per 24 hours.

It is stated (page 417) that the preliminary filters working under a pressure or head of 13 feet are in capacity for a given period 200 times greater than the ordinary filter bed. How this assertion squares with the fact is seen from the following figures, based on the area given for the Astrachan filter of 1050 square feet.

$1050 \times 200 = 210,000$ square feet of filter beds. The capacity of the former is given as 1,120,000 gallons in 24 hours, whilst the capacity of the latter for effective work is generally accepted at 500 gallons per square yard in 24 hours, so that the capacity of the filter bed is $210,000 \div 9 = 23,333\frac{1}{3}$ square yards, which totals no less than 11,666,666 gallons in 24

hours, or nearly $10\frac{1}{2}$ times the capacity of the Astrachan filter at Mr. Steiger's own calculation.

The real fact is, that for the quantity given—viz., 1,120,000 gallons per day—the areas required respectively are as follow: for the process of preliminary filtration, 1050 square feet, or $116\frac{2}{3}$ square yards, against 2240 square yards for the whole process for ordinary filter beds, or a little over 19 times in favour of the former in place of 200 as claimed.

Were this all it would still show much in favour of the preliminary process over the ordinary filter bed, but confining the question to capacity only, we have still to take into account the surface required for the secondary filter, which according to the Astrachan plant as shown, for example, is a space of 1016 square feet. This, then, further brings down the difference of 19 times, as previously shown between the two processes, to less than 10 times.

But there is a wide discrepancy between the area given as required for the Astrachan secondary filtration, and the later description giving particulars of the general features of the process (on page 417). The article reads: “The secondary filters, which remove the fine organic matter suspended in the water, can, according to local circumstances, be worked either under high or low pressure. In the first case, their capacity is about half the capacity of the preliminary filters, and the total pressure for both filters 25 to 29 feet; while in the second case, under low pressure—namely, about 32 inches—they require 10 times the surface of the preliminary filters, but still exceed the capacity of sand filters 25 times.”

Leaving this assertion for the moment, it appears that the Astrachan secondary filter surface should be given at double the area of the preliminary filters, or instead of the area being as given—viz., 1016 square feet—it should be 1050×2 , or 2100 square feet. This further reduces the difference of 10 times by one-half, or down to five times, and then taking the space given by Mr. Steiger as required for low pressure—viz., as 10 times that of preliminary filtration under high pressure—it seems doubtful where the advantage exists, as regards space, between the process and the ordinary filter bed for any given quantity per day.

It seems equally problematical where the advantage would be under high pressure, putting aside the fact that economical filtration under pressure is opposed to fact and experience, for against the five times saving in space must be put one of the following conditions—i.e., to either mechanically raise the water a height of 25 to 29 feet, or otherwise lose that height or head in gravitation level.

Looking now at the process from a purely sanitary point of view, in its comparison with the filter bed, we get at the following facts, if we are to allow Mr. Steiger but a portion of what he claims. On page 416 he refers to the nature of the Manchester supply, and quotes the well-known feature more or less of all surface-collected water—that is, the odour resulting from putrescent organic matter.

He is perfectly correct in saying that sand filtration does not affect to any appreciable extent the removal of this odour, and he might have gone further, and said that no amount of filtration under existing circumstances would remove it sufficiently; still there can be little doubt that the removal of this condition, common to all partially stagnant water, is the one thing required to restore not only the Manchester supply, but, generally speaking, all our public water supply, to a sufficient degree of purity.

The comparison to be drawn between the two systems under notice is this, that sand filtration, in even a short period, is decidedly injurious to the

water, from its having to percolate through the accumulated or arrested matter on the surface, this arrested matter to a large extent giving to the water the odours to which Mr. Steiger refers.

If this is admitted, then it is obvious that unless the cylinders were washed out at very short intervals, the same effect to a greater degree would occur from the water being forced through a solid stratum of filth, collected or arrested in the cylinder bottoms, assuming it to be correct that this matter, from causes mentioned, cannot enter into the body of filtering materials to a greater extent than necessitates their washing out only at intervals of a year or two. Such a supposition as this is entirely opposed to all experience, and is equally opposed to the conditions required by recent scientific research and experiment in the purification of water.

Taking the Astrachan example as a case in point, the only conclusion to be drawn by any one conversant with the principles of filtration is this, that the water treated there by the Gershon process requires but the simplest treatment, and is, moreover, a totally different quantity from such a water as the Manchester supply; equally so it may be considered doubtful, if applied to such a water, the process would much exceed in quantity alone for a lengthened period the capacity of the ordinary filter bed, though it may be freely admitted that the process, by dividing filtration into a preliminary and secondary process, is a step in the right direction.

The proportion to space of water filtered by the two processes mentioned is for sand filters—without pressure—about $2\frac{1}{2}$ gallons per square foot in one hour for an average of 500 gallons per square yard in 24 hours; but it is obvious this quantity in no sense represents the actual work done, as the filter area immediately it is put in operation is reduced, by reason of the blocking up of the sand by arrested matter. 10 days are generally considered the *limit* during which it remains effective under favourable circumstances, and we may safely assume that in the later period of its existence especially, to obtain this average of 500 gallons for the whole period the quantity will vary from the minimum of $2\frac{1}{2}$ to a maximum of 20 or 25 gallons per square foot in an hour. This condition of increased quantity, and necessarily in the inverse ratio *a decrease* in the mechanical action of the filter, combined with the contamination of the water by arrested matter, explains the unsatisfactory state of our water supply in connection with sand filtration.

The proportion of space and quantity of water filtered under pressure according to the Astrachan example is about 45 gallons per square foot an hour, but the proportion is on the assumption that the space given, 1050 square feet, for 120,000 gallons per day, is that of the cylinders themselves. If it means the space occupied by the plant, then the proportion given would be increased three or four times, or approaching 200 gallons per foot in an hour. It requires a robust faith to believe that a satisfactory degree of purification would be obtained by means of filtration with either proportion given on water previously forced through a more or less solid stratum of arrested filth; and this would necessarily be the case if the one principle on which the process depends for success achieved its object, and that for a much shorter period than two years. The feature mentioned is simply a more concrete example of the same condition attendant on sand filtration. The most recent experiments of British and American experts relative to the purifying effect of filtration, prove conclusively, at all events so far as the elimination of germ life is concerned, that in no sense can it be said that sand or other filtration is sufficient to purify a water contami-

nated with other than the simplest forms of suspended matter. My own contention will be that a sufficient degree of agitation by air under pressure is the natural remedy for eliminating impurity, whether soluble, gaseous, or germ life foreign to natural pure water, leaving filtration to perform that part of the process of liquid or water purification for which only it is fitted—the arrest of suspended matter. The proportion of space and quantity in the system I shall propose will be a maximum of 17 gallons per foot in an hour, or probably about the actual work done by filter beds for the greater period of their existence.

The question of water supply is one that of late years has occupied the attention of scientific experts, principally on account of the new terror of the discovery of germ life and its connection with epidemic disease. Great interest has attached to the investigations, and especially so in Britain and America. You no doubt are aware of Professor Pampelly's experiments at Newport, for the National Board of Health of America, and also of Dr. Frankland's experiments in the same direction. These experiments have thrown much light on the subject of bacteria and the means for their removal from water. Drs. Tidy and Dewar are continuing the experiments, but practically Dr. Frankland's paper on the purification of water, contained in the proceedings of the Institute of Civil Engineers, vol. 85, part 3, may be considered the most authoritative textbook of science on the subject.

As regards filters, Dr. Frankland is much more favourable to their efficiency as a means for the removal of germ life from water than are most other observers, in fact his conclusions are in direct contradiction to American views, as Professor Pampelly found that water, after being filtered through several feet in thickness of sterilised sand, contained living micro-organisms. Dr. Frankland reports that a filter of ferruginous sand six inches thick entirely removed micro-organisms at first, and that coke and animal charcoal were efficient in straining out bacteria. He concludes that it is no very difficult matter to construct filters which shall remove micro-organisms for a time at all events, and which will do this without exerting any special chemical action on the organic matter in the water, but that even in the case of the best filtering materials there is a necessity for frequent renewal.

Dr. Frankland's experiments in agitating water with suspended particles of spongy iron, etc., showed that while over 90 per cent. of germ life may be removed in this way, yet the process is unreliable, and in some cases the number of organisms was actually increased by the process; but he does not appear to have experimented in agitation with air, or bringing it into contact with every part of the fluid. This view of the case is strongly held by American experts, and such a process is known to have a powerful effect in destroying the vitality of micro-organisms, and good reasons exist for supposing that this destructive effect is exerted more powerfully and promptly upon the more dangerous forms of germ life than it is upon the more harmless forms. It is easy to understand that bacteria, which only flourish in the absence of oxygen, would be destroyed by a thorough process of aëration and removal of odour. The results described by Warrington in connection with sewage point to the same conclusion, and in further confirmation Dr. Frankland points out that it is more difficult to remove from water some kinds of organisms than others, and that those bacteria which cause liquefaction of gelatine, among which are some of the most dangerous forms, are more readily destroyed than those which do not effect such liquefaction.

With regard to precipitation methods, Dr. Frankland's conclusions are that chemical precipitation is attended with a large reduction of micro-organisms present in the water, but if agitation or precipitation be continued too long, the organisms first carried down may again be redistributed in the water. For this and various other reasons, then, this process does not appear to me as worth consideration, or at all events in connection with potable water. But in the fourth or last process of purification by natural agencies, Dr. Frankland's conclusions are of the highest value, and I quote the conclusion of the report which deals with the subject:—

"Finally, it should be observed that processes for the purification of general water supplies are desirable, not only for the removal of dangerous micro-organisms, but also for the removal of matters which are offensive to the senses—to clarify water from suspended particles of clay, etc., which make it unfit for bathing, to remove algae, and to oxidise and destroy certain matters which cause offensive odours. For all these purposes simple sand filters are useful, and if these are constructed of ferruginous sand and combined with means for agitation and thorough aëration at certain times, the results will probably be satisfactory."

In the system of liquid purification I shall lay before you, I shall claim that every condition laid down by Dr. Frankland is fully achieved. I may remark that the only difference is that I propose *constant* in place of occasional aëration. I venture to attribute this to the fact that I have in my mind the purification fit for potable use of a class of waters not anticipated by Dr. Frankland; and to the same cause may be attributed the reason why the system of purification to be described "seems" to go further than the conditions of Dr. Frankland require. Practically speaking, these conditions are complied with by, say a preliminary and secondary process of filtration. Means being provided by which a frequent renewal of the materials may be obtained at reasonable cost, the condition of agitation and aëration I suggest will best be obtained by agitation with air. I claim this process, in the way it is obtained, has a threefold effect in comparison with aëration superficially or by injection. These effects are (1) elimination of the original gas or odour; (2) revivication and natural disinfection by each particle of water being washed in fresh air; lastly, the destruction or development of soluble impurity foreign to naturally pure water, the same terms applying to the destruction of germ life, the full process rendering soluble matter and germ life amenable to the general law of subsidence or the process of filtration.

I venture to think the conclusion put forward complies with the conditions required by the most recent scientific discovery, which shows that a high temperature in water is conducive to the propagation of microbe life, whilst a low temperature has an opposite effect; and surely, so far as drinking water is concerned at all events, we cannot conceive a more rational or natural process of cooling than that of aëration, besides the fact that by natural law aquatic animal life seems equally impossible in presence of an abnormal quantity of air, as non-aquatic life is, we know, impossible in presence of an abnormal quantity of water.

In briefly describing the system and apparatus employed for your consideration, I will, for convenience, divide it into four sections. The first pre-preliminary, the second preliminary, and the third I will call the geological section. These sections I propose to employ for the purification of water for domestic use, the fourth section being devoted for the purpose of artificial or chemical treatment of water for trade purposes.

The whole of the sections named may be either embodied in one system, or each may in itself be used separately for the purpose in which it is employed in the system under notice, so that the treatment only may be employed which circumstances require, with economy in both space and cost.

For the sake of brevity I will ask you to assume that gravitation is the only motive power employed, except the generation of a forced current of air, and also to consider that between the first and third sections a drop of about four or five feet occurs in the gravitation level; but, allowing for this fall, then the purified water is discharged from the third or geological section at the same or about the same level at which the water enters the pre or preliminary section. It will be readily understood this feature would modify in many cases the expenses of pumping, and that water by gravitation alone would reach a higher level than is possible with the ordinary filter bed in use.

1st Section. The first or pre-preliminary section consists of a tank or vessel that may be, say either 2 feet or 2000 feet in length; in fact, of just sufficient size according to the quantity required, which is determined by a sufficient syphonage effect produced on the particular water passing. The tank is provided with an inlet and outlet at each end. This allows of the water traversing the filtering media in reverse directions, or from right to left as required, the labour achieving this result being simply moving a valve or shuttle. The filtering or syphonage materials are contained in strong, open, iron-work frames, which are fitted in slides or columns, and so are withdrawable as occasion requires for the renewal of filtering material. I propose not less than two lines of filtering stratum in this section, the first acting as a guard or a preliminary filtration to the second. The general features are two lines of filtering stratum, which divide the body of water into three columns or strata, the vertical strata of water being three or four inches wide. This brings into play not only the rapid syphonage through the filtering media of the water as it traverses longitudinally the faces of the filtering stratum, but also that of friction on the side of the tank. The depth of the filtering stratum is governed by the rule as to quantity, but in all cases I propose the bottoms should be a greater depth, to be governed by circumstances, than the bottom side of the filtering stratum, so that provision is made for the collection of suspended impurity below the filtering media, which admits of the law of subsidence taking place. The element of cleanliness is provided for by the tank bottom, if small or medium in size, sloping from back to front, the front being the inlet side, and to one end, or if large, then from the centre to both ends, at which a sludge door or valve is provided to discharge the accumulated deposit, whether existing on the bottom or sides or on the face of the filtering media. The vertical columns or strata of water at the moment standing on both sides and between the filtering stratum will automatically flush them out in any part by the rush of the water to escape at the valve opened at the lowest point of the tank for the purpose; it will be observed that by the water traversing the face of the filtering stratum the collection of matter on the surface is reduced to a minimum. Further, the collection of matter is always subject to removal by the action of, the current of water, which, although in itself slow would have a tendency to remove it and cause its deposit on the bottom; again, it must be remembered that provision is made for subsidence of matter, and that the current of water may be reversed at pleasure. With these features of keeping the filtering media effective as long as possible, must also be taken into account the fact that, although the

accumulation of matter on the filtering surface would have to take place during the slow gravitation of liquid, yet by the feature of cleansing out its removal is effected by a violent discharge backwards of the water standing between and behind the two strata of filtering surface: the water in the inlet or front side of the filters having no impediment would immediately rush out at the valve, carrying the deposit with it, but the water in the centre and back strata must come back through the filtering media, and cannot fail, under the circumstances described, to automatically dislodge and flush out any matter accumulated either on the surface or in the body of material. Shortly, I propose the defilement of filters shall occur "without pressure," but their cleansing and flushing out be effected under considerable pressure in the opposite direction.

I should mention here that the loading of the filter frames is, by a simple contrivance, made an easy matter, and may also be made use of for exposing the water to the action of other substances than sand; for the first line I should generally propose a coarse sand, but there seems no reason why the second line should not be, say charcoal, for instance, nor need this be of any great quantity, as by the contrivance mentioned a frame may be loaded in a few minutes with, say two or three different strata of material, for instance, two outer strata of fine sand, enclosing a stratum of charcoal or other substance; in this way it is quite possible to carbonise public water at a slight increase of cost over sand.

The general features and process of this section may be called the process of syphonage in combination with subsidence and gravitation, coupled with reasonable means to ensure cleanliness and efficiency of work, and may be considered as sufficient for a pre-preliminary purification of water; the function of this section in the system proposed is the arrest or filtration of suspended matter.

The second section consists of two tanks or vessels, one corresponding to the first section in capacity, the other, which varies in size according to the quantity of water purified per hour or day, stands between the two; the water, after undergoing the process described, enters this apparatus, when a fall or alteration in the gravitation level takes place; by an arrangement of spray plates the stream of water is converted into a shower or spray, which is arranged to fall in a circle. The inner part forms a funnel, and communicates with an outlet in the cover, which is extended on by pipes away from the site of the works; the floor of the apparatus is the gravitation level of the water, and immediately above this level are the inlets for the forced or induced current of fresh air, which passes through the falling spray into the funnel or inner circle, and out by the opening at the top; as, except this, there is no other outlet.

The process, then, is seen to correspond to some extent with the most perfect, because natural, process of aëration, or a shower of rain in a high wind; and in consequence, as every drop of water must be affected or aërated, so must the original odour contained in the water be blown out and replaced by fresh air. It must be noticed that the falling spray is subjected to the freshest air immediately before reaching the gravitation level, and necessarily carries with it a certain quantity, so that the water at this point is doubly aërated by falling through and being washed in air, and afterwards undergoing the reaction attendant on the process or oxidation as hitherto applied for this purpose.

I venture to think Dr. Frankland's essential conditions of thorough agitation and aëration are fully achieved by the process described; in fact, with a

sufficient pressure of aërating current, the water is literally broken up into vapour; but this would only be necessary for an exceptionally foul-smelling water, that by ordinary means would be utterly unfit for potable use; for ordinary water—such, for instance, as the Manchester supply—a sufficient degree of aëration would be obtained by the induced current of air generated by the falling water. This, aided by ventilation, would in most cases be sufficient to disinfect and remove odour, and to revivify the partially stagnant water of most reservoirs, wells, and similar sources.

The second tank of this section is similar in construction, and in filter area is exactly the same as the first section; the filtration is primarily a guard against the intrusion of matter into the third section, and the same features as to cleanliness and automatic flushing-out of the second tank and filtering stratum apply as already mentioned.

The general features and process of this section are the extraction of foul gas or odour and the process of filtration, combined with subsidence and gravitation, coupled with reasonable means to ensure cleanliness and efficiency of works. The function of this section in the system proposed is the production of a neutral or pure water, by reason of the elimination of gaseous and soluble impurity, and destruction of germ life.

I venture to suggest that the system described up to this point is in accord with, and meets, Dr. Frankland's conditions to produce satisfactory results in purification by natural agencies, the process being—first, filtration through two strata of sand or other material, six inches thick, and renewable at reasonable cost as often as required; secondly, thorough aëration and agitation, and again filtering through two strata of sand, and renewable as often as required.

Assuming the water, after undergoing the process described, is to some extent a pure or neutral liquid, corresponding in some degree with rain-water, then it is peculiarly fit and amenable to the impregnation of mineral salts, or, in other words, to receive the constituents of natural spring-water, and this process is the function of the third, or geological section, which consists of two tanks, or vessels of similar capacity to those of the other section mentioned, and possessing the same features with respect to reversing the current of water at pleasure, and also the feature of flushing-out or cleanliness. The tanks are connected by a syphon placed a certain distance above the sloping floor, the inlet and outlet ends being protected with an iron grating. The water below the syphon being still, allows of the subsidence of any matter or particles of material falling below its mouth, and of being flushed-out as occasion requires. I should remark here that each section may be flushed-out separately, as by simply moving two valves the inflowing and outflowing stream is cut off.

The formation and nature of the impregnating strata admits of endless variety; in fact, the chemist in this direction has the whole geological and some portions of the vegetable world to choose from.

I do not propose to enter largely into this subject, although, from every point of view, the section and its function in the system proposed is the most interesting, and which is, practically speaking, the artificial production of spring-water by using the same means, *in comparison to the effect of the lower stratum of the filter-bed.*

I may perhaps be permitted to show a typical form of strata, and briefly point out how this section seems to meet a recent scientific communication by Dr. Tidy to the Royal Society touching the subject of water purification and its effect on lead pipes, and

how the full effect of the suggestion could be obtained in this system of water impregnation.

Assuming, then, the two tanks are empty, I first propose to fill them up to the level of the connecting syphon with rough lumps of limestone or other stone. This is to allow of a comparatively free rush of the water to the flushing valve when open. Then on this rough substratum of loosely-packed rock may come chalk, for instance, then sandstone, then charcoal, then sandstone again, and lastly, a stratum of filtering sand, on to which the water from the second section would discharge. It would then pass downwards, percolating through the impregnating strata to the opposite end of the tank; and then passing through the syphon into the second tank, it commences to rise or spring gradually until it reaches the outlet at the opposite end, the process being downward and then upward filtration governed by the law of gravitation.

At the recent Birmingham meeting of the Royal Society, Dr. Tidy communicated a paper on the subject of silicising water by bringing it in contact with old red sandstone, for the purpose of neutralising the effect on some water in corroding lead pipes, expressing the opinion that its effect would be to minimise the danger to health from lead poisoning, and to also purify the water. I believe this idea has been mooted in connection with Loch Katrine supply, and it was proposed to bring the water to Glasgow in a red sandstone conduit. It will readily be understood that, had this idea been carried out, the effect could not have been more than very slight under the circumstances named. But taking the geological section of the system proposed, it is equally obvious that the strata could be either wholly or partially of this material, and consequently the degree of impregnation may be that found most desirable by experiment or experience. The same rule applies, of course, to all other substances under similar circumstances, and I respectfully suggest that there seems no good reason why the geological chemist should not supply, under the conditions named, a water for public use in the largest quantity, possessing to a degree the characteristics and constituents of almost any favourite natural spring water, and produced under, practically speaking, similar circumstances and the same natural means.

But if I may be permitted to say so, is the fact just stated with respect to Loch Katrine water, and its effect on lead pipe, the only one of importance or interest to the city of Glasgow? I venture to think it is not. I refer to the generally accepted idea as to increase of infantile deformity, which by many people is rightly or wrongly put down to the use of this water in a large measure; or, shortly, it may be said that Loch Katrine water is a magnificent water for most trade purposes, but for domestic use is deficient in one at least of the attributes of a health-giving and wholesome water. This idea may or may not be true, but assuming that it is, then I confidently assert it would be an easy matter to give to this water, by the means proposed, that constituent or attribute in which it is deficient.

I venture to ask you to consider the facts put forward in the light of showing how it may be possible, by the means proposed, for the chemist to fix standards of purity for public water, irrespective of the nature or quality at its source or point of collection, this matter being reduced to the simple question of cost, or, shortly, the period required to obtain the standard of purification fixed upon. This is determined by a simple rule of capacity for a given period, and is entirely under control, the capacity of an apparatus being determined in its relation to the flow of liquid. For instance, the

flow of water required is say 1000 gallons per hour, and the standard of purification requires 5 hours say, then the apparatus requires to be in itself of not less than 5000 gallons capacity. Then the water of necessity is 5 hours in passing from the inlet to its outlet. From this simple rule it is seen that the system gives perfect control in this most important matter, as the flow may, in addition to the features given, be varied at pleasure by the connecting valves provided for the purpose. And I venture to think the general features of the system, as outlined, tend to show that the purification of water may, by the means proposed, be reduced to a practical science and give the geological chemist the means of fixing and maintaining standards of purity, and is, practically speaking, the artificial production of spring water using the same means.

The fourth section, for the preparation of water for trade purposes, is also a question of great importance to the industrial chemist and manufacturer. I do not propose to go into this matter further than describe the apparatus and to say it may be used alone or in conjunction with either or all of the other three. The principal feature of difference in the 4th section to those for purifying water, is the provision made for settling and accurately mixing with a flow of water any chemical or liquid for precipitation or giving the water an artificial chemical constituent. The provision consists of a shoot, provided with a hopper at its upper end to hold a supply of lime or other chemical which is delivered to the inflowing stream as it passes under the shoot by a pair of rollers, or, if a liquid, by a tap from a vessel which takes the place of the hopper, the effect being an accurate and automatic impregnation of the liquid at slight cost in comparison to the usual means. One feature of the section is, that after such impregnation and precipitation of mud has taken place, the effluent water may afterwards be filtered or otherwise treated as described for water for potable use. In addition to this is the feature that by using the second section it is in the power of the chemist to produce a neutral or soft water from impure sources—a water that is undoubtedly valuable for trade purposes and not readily procurable by other means; and it is not too much to expect that, given such water as this, corresponding to a great extent to natural rain water, the industrial chemist could produce results of great importance to several branches of manufacture.

I venture to hope that taken as a whole the system proposed opens up a wide field of practical science in the purification and treatment of water, in comparison to the novel and mechanical process in use, and does in effect transfer the purification of water from such admittedly inefficient condition into a system of geological and natural science.

The cost of purifying water by this system I estimate at about the following rates per 1000 gallons for medium and large quantities:—

For 100,000 gallons per day, constant work, about 1½d., including forced aëration, and all cost of upkeep and 5 per cent. interest on capital; on the same terms, with automatic aëration, ½d. per 1000 gallons would be sufficient for 500,000 gallons per day, including forced aëration and all costs and charges; the rate would be 3½¹/₂th of a penny per 1000 gallons. I do not advise a single apparatus of a larger capacity than half-a-million gallons daily, and as any number of the apparatus may be embodied in a system side by side, it fully meets the necessary condition of purifying water on the largest scale, with economy of space and cost.

The estimates given are for all three sections combined, or for purifying water for domestic use, while for filtering alone by the first the cost would be about

one-fourth that given. For filtering and agitating, and again filtering by a combination of the first and second, the cost per 1000 gallons would be about three-fourths that of water for potable use.

Space occupied by the whole system in comparison to filter beds:—The system: 100,000 gallons per diem, 729 feet; for filter beds, 3600 for constant work. The system: 500,000 gallons per diem, 3150 feet; for filter beds, 18,000 for constant work, with an average of 500 gallons per yard in 24 hours, or the best average work possible to the process under favourable circumstances—similar circumstances as to one reserve filter bed to allow of renewal, etc., to several others apply in both cases.

Having described the general features and process of the system, I would just indicate a few applications to which as a whole or in part it may be applied for liquid purification.

The first section may be used alone as a substitute for ordinary filter beds, and for purifying water from rivers for trade purposes and where ordinary filtered water is sufficient. A saving would be effected in labour and pumping, etc., as the filtered water would be obtained at the gravitation level of the stream supplying the impure liquid, and generally for all purposes of simple filtration the sections supersede sand filters with advantage in economy of space and cost.

Where a purer and softer class of water is required, the first and second sections may be combined, and in the case of manufacturers especially a forced pressure of air may in most cases be cheaply obtained, in which case the fall or gravitation level need not be much more than one foot as the difference between that at which the purified water is supplied and the level of the impure supply, and in any case would save both space and cost as between an ordinary filter bed.

The second and third sections without filtration may be used with advantage for revivifying and, practically speaking, transforming the nauseous and insipid, condensed, or stagnant water on board ship into natural spring water, using the same means.

The apparatus may be elevated over a contaminated well or other source of supply in country and isolated districts for villages, institutions, etc., and the water be pumped in. This would represent the extra labour, as pumping in, say a bucket of impure water, simply forces out by gravitation a similar quantity of purified water, which of course could be carried away, or in pipes would gravitate to any point required as a compensation for the extra labour in pumping. This form I think would also be very useful for farm premises, etc.

The same rules apply to a constant stream of water entering the apparatus by pumping, gravitation, or syphon, and either from the apparatus direct, or from a reservoir into which the apparatus or system would discharge the purified water; in this way it is possible to store and utilise water in districts and under circumstances not possible by the means in use, and also, if circumstances permit, accompanied by the convenience of having a gravitation water supply at slight cost. Of course, the pressure would depend upon exactly the same circumstances as those which apply at present by ordinary means.

The apparatus may be made small enough to suit a single house or a mansion, or may even be used in connection with a water cisterns, etc. A flush out at any time is obtained by turning a tap, and the filtering material, etc., is easily renewed. In relation to space, and for a given period, no other description of domestic filter would approach this in quantity or quality of water.

Lastly, in a modified form it admits of being made portable, and in that way used for filtering; and if two

apparatus were joined, also for agitating and aerating water for miners and for soldiers, especially in such countries as Egypt or India, where the water supply is generally bad. The apparatus, which resembles a cart on wheels, when not in use for its primary purpose would be useful for transport.

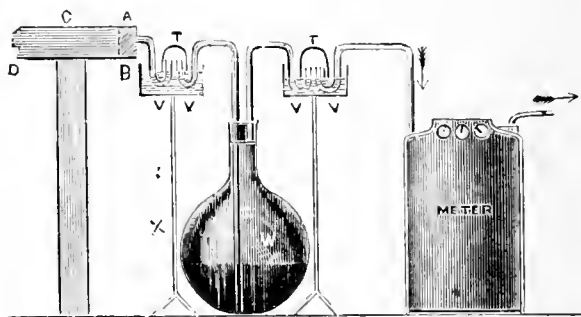
NOTES ON RIVER WATER PURIFICATION BY THE AGENCY OF ATMOSPHERIC OXYGEN.

BY J. J. COLEMAN, F.L.C., F.C.S.

PASTEUR and his school have assumed that some forms of organic matter, such as albumen and fibrin, are practically indestructible by any ordinary atmospheric agency, without a previous splitting up by bacterial life. Experiments have been made by Lister and others, which show that milk, urine, etc., will keep several years in contact with air deprived of micro-organisms. Some experiments have, however, seemed to me desirable with ozonised air, not only as regards its action upon dead organic matter, but upon micro-organisms themselves.

M. Davy (*Compt. Rendu*, lxxxii. 157) states that atmospheric air frequently contains one milligramme of ozone per 100cc., but assuming that M. Houzeau (*Ann. Chem. Phys.* [4] xxvii. 5) to be correct, then the atmosphere sometimes contains $\frac{1}{150000}$ of its weight, which would be equivalent to about 2 cwt. of ozone per acre of the earth's surface. Houzeau has, however, provided a well-known apparatus for obtaining a constant stream of atmospheric air more highly charged with ozone than is natural air.

The ozoniser I used for my experiments (see diagram) consisted of a tube about 500mm. long, the terminal wire of a Ruhmkorff coil, capable of giving sparks two or three centimeters long, being wound round the exterior of the tube, and the other terminal wire being made into a long spiral filling the inside of the tube. This arrangement was placed on a still wider tube, A, B, C, D, 50 millimetres diameter, through which a constant



stream of air was made to pass by means of an aspirator. A constant copper battery was used in order to maintain the silent discharge, and the ozonised air was first passed through the flask W, and then through the dry gas meter M, and finally discharged through the aspirator.

As the ozonised air acts rapidly on indiarubber, the glass tubes were fitted into the flask by paraffin wax cement, and the entrance tube and exit tube from the flask were plugged with cotton wool, the flask being capable of being detached from the rest of the apparatus by lifting two wide test tubes dipping into the water late V, V, V, V.

The flask W generally contained about 100cc. of the liquid being examined, and it was found that when the air was passed at the rate of 200 cubic

inches per hour, there was no inconvenient splashing of the liquid, and under such circumstances the quantity of iodine liberated per hour from potassic iodide solution equalled 0.068 of a gramme.

Several preliminary experiments were made with vegetable infusions, such as those of cauliflower, which under ordinary circumstances become opaque in a day or two from bacterial life. In all cases it was found that so long as the ozonised air was passing, the liquids remained pellucid, and even for several days afterwards, provided the cotton plugs remained intact, but that in every case opacity developed in a few days after ceasing to pass the ozonised air through, showing that whilst the mature organisms were killed the spores must have escaped destruction by the ozone.

It was then thought advisable to make the experiments with pure soluble albumen, and for this purpose a five per cent. solution of white of egg was employed, carefully filtered, and the ozonised air was passed through the flask, containing 100cc. of the liquid, for six hours. A similar solution outside the flask became opalescent in 48 hours, whilst the ozonised sample remained clear until the fifth day, when it then gradually increased in opacity notwithstanding the cotton plugs. Here again was evidence of the fact that it was easy to destroy micro-organisms, but very difficult to destroy spores.

These preliminary experiments demanded more minute attention in the final experiment. As before mentioned, the ozonised air liberated 0.068grm. of iodine per hour from iodide of potassium, and it was arranged to pass the air thus ozonised for 10 hours a day, three days consecutively, through 100cc. of a one per cent. solution of white of egg, which it will be noticed would bring the ozone into contact with about its own weight of dry albumen. The experiment was very successfully performed, great care being taken to stuff the entrance and exit tubes of the flask with $1\frac{1}{2}$ deep inch plugs of cotton wool, and the induction coil was carefully kept going by a man specially watching it. The aspirator was first stopped, and shortly afterwards the induction coil so as to be sure no *unozonised* air was drawn in. The whole was then left at perfect rest for six days, the liquid remaining pellucid and bright until the fifth day, when a slight cloudiness manifested itself. On opening the flask the liquid proved to be quite neutral, and yielded the usual precipitate with nitric acid (of unchanged albumen). On evaporation to dryness the proper percentage of albumen was obtained, and there was no evidence by the microscope of any crystallised product; the air after passing through the liquid acted strongly on indiarubber. Albumen, it has been shown by other chemists, also resists the action of a 20vol. solution of peroxide hydrogen. It is possible that both these active agents, when in a more concentrated form, may attack albumen, but these experiments are conclusive as to the *practical* indestructibility of albumen by any *atmospheric agency* whatever, without a previous splitting up by micro-organisms. It must, however, be borne in mind that atmospheric air acts as a natural purifier of water *indirectly*—namely, by increasing the activity of organisms, which, as soon as they have performed their functions of oxidation, disappear and die for want of food. Purification of water or sewage is, therefore, promoted by aëration—putrefaction, as Angus Smith surmised, being a necessary preliminary to oxidation and purification.

DISCUSSION.

Dr. WALLACE hardly thought that Mr. Hartland did justice to the system of sand filtration, as he had in his memory a series of sand filters which filtered

daily four million gallons of water. These filters were, therefore, worked upon a somewhat extensive scale, and during the winter months were used about six weeks each without renewal. It was quite true that in the summer—say in July and August—they were only in use about ten days, as Mr. Hartland stated; but it would certainly be unfair, in his opinion, to take that as the average duration of a sand filter; about three or four weeks would be a fairer average.

Mr. CURPHEY would have liked to have had a little more information as to the results which had been attained by this process. Many had been struck by the shortness of the time which would elapse between the aëration of water and its consumption. Five hours were not, in his opinion, too long a time for the removal of oxidised impurities, and measured results would certainly be very valuable in this case.

Mr. COLEMAN had omitted to say that the practical bearing of his paper was this, that—as Dr. Angus Smith had surmised—no water purification could take place without putrefaction—*i. e.*, before the matters which are in water, such as albumen, could be destroyed, there must be putrefaction. It was in fact a necessary preliminary to purification, and was, practically, promoted by aëration. This arose from the fact that the micro-organisms lived upon oxygen, and Mr. Hartland was quite correct in contending that to aërate water was to purify it. His experiments had been instituted rather with the view of ascertaining the possibility of purifying water—Thames water for example—by means of the ozone naturally contained in the atmosphere. He thought, however, that this could not be done.

Mr. E. C. C. STANFORD was not aware whether anyone present had had any experience with Pasteur's filter. He had used one for some time, and had found it very efficient. In construction, it was simply a long tube of biscuit porcelain, and while filtering very slowly was still very efficient. Although requiring cleaning very often, the simplicity of its construction enabled one to accomplish that very easily, as the outside of the tube required merely to be wiped and the tube screwed into the electro-plated case.

Professor MILLS: It had been conclusively proved both by Dr. Frankland, Dr. Percy Frankland and Mr. Coleman that mere oxygen did not act upon organic matter suspended in water. If they supposed the organic matter in water was, for the time being, a kind of sewage, the introduction of germs would facilitate the purifying action just as yeast is used to start the process of fermentation. The action would be hastened by the passage of air through the liquid. Touching on Mr. Hartland's suggestion that Loch Katrine water should be impregnated with chalk or limestone, this was, he said, really a very old notion. It was in the mind of Mr. Bateman when he constructed the waterworks, and there was to be seen at Mugdock Reservoir a breastwork constructed then in connection with the matter.

Mr. HARTLAND, in reply, said that in his opinion aëration was simply an incident in the process, just like filtration. He understood that Dr. Wallace in speaking of sand filtration, had referred to the Glasgow water supply, but he would ask if Dr. Wallace considered Manchester water to be on a par with Glasgow water, or that a similar quantity of the former would be passed through the same stratum of sand as the latter, with a similar purifying effect. His experiments had led him to hold that aëration, without violent agitation, was of little use, but that the passage of a current of air through a spray of falling water had the effect of developing soluble impurities, and had such an action on germ life as to render it amenable to the law of subsidence.

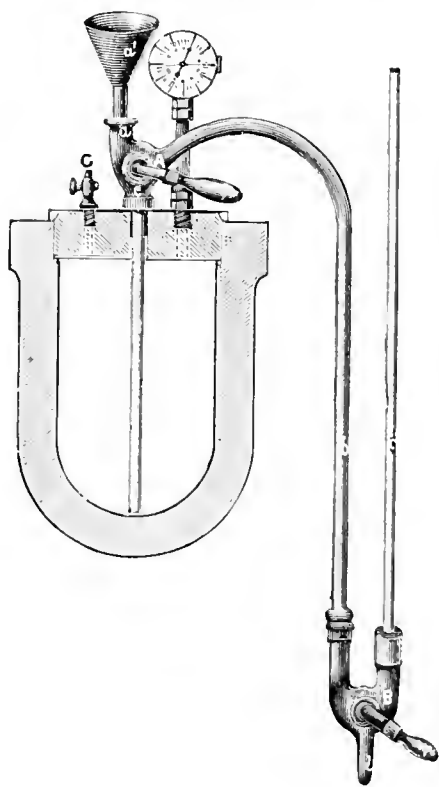
Professor MILLS at the close of the discussion exhibited some candles which were prepared with the view of preventing "guttering." The process was very simple, consisting in giving to ordinary paraffin candles a coating of a certain varnish. As the candle burns, the varnish forms a cup which holds the melted paraffin, and "guttering" seems to be very effectively prevented.

Journal and Patent* Literature.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Apparatus for emptying Autoclaves by Automatic Means. Chem. Zeit. 10, 1273.

THE apparatus illustrated in the accompanying drawing is attached to autoclaves. It admits of the withdrawal of samples or the addition of liquor during the procedure of an operation, whilst after its completion the contents may be removed without disturbing the cover. When



the apparatus is at work, the three-way valve A is adjusted so as to prevent passage through the pipe c. In order to take a sample the three-way cock B is made to communicate with b and d, and the valve A turned with a jerk to connect c with b; the sample is then withdrawn at d. To completely remove the charge the valve A is

left open for some time. In working without pressure the air-cock C is opened and communication established between b and c and a and b. b and c are then filled with liquor identical in constitution with that contained in the apparatus, obtainable from a previous operation. The contents of the vessel are then removed by restoring the communication between c and b and b and d. To introduce liquor into the apparatus without removing the cover the air-cock C is opened and the funnel a' made to communicate with the pipe c by regulating the valve A. This apparatus is constructed for a pressure not exceeding fifty atmospheres, and is applicable to autoclaves of a maximum capacity of fifty litres.—D. B.

Improvements in the Manufacture of Thermometers. J. J. Hicks, London. Eng. Pat. 2027, Feb 13, 1885. 6d.

It is a well-known fact that thermometer tubes after filling undergo a contraction or shrinkage, which in time becomes so considerable that if the thermometer were graduated immediately after the manufacture and filling of the tube, the indications would soon show considerable inaccuracy, and in twelve months' time might amount to as much as one degree rise. To prevent this inaccuracy it has been customary to store the filled tubes for a year or more previous to graduation, but as this is not quite certain, and is certainly not economical, the inventor adopts the plan of gradually heating the filled tubes to a temperature about 100° F. higher than the highest point of the thermometer for a period of about sixteen days, and in order that the tubes may not burst from the expansion of their contents, an enlargement or chamber is blown at the upper end of the tube sufficiently large to allow for the maximum expansion. After gradual cooling the thermometers are graduated, the enlargement or chamber being either sealed off or retained.—W. D. B.

Improvements in Graduated Chemical, Medical and other Liquid Measures or Ganges of Capacity and Pressure, and in other Graduated Tubes, Bottles, Jars, Syringes, and Articles made of Glass. J. J. Hicks, London. Eng. Pat. 2347, Feb. 20, 1885. 8d.

ACCORDING to this invention, graduated chemical and other apparatus is made of glass with one or more longitudinal strips of white or coloured enamel or glass on the exterior or interior surface, or embedded in the body of the material, one or more spaces of clear glass being left between the widths or bands of opaque enamel to enable the height of the contents to be read off. The graduations are engraved, painted, or etched upon the opaque widths or bands, and extend right up to or even cross the transparent or clear widths.—W. D. B.

Improvements in Thermometric Apparatus. A. G. Brookes, London. From E. W. Upton, Peabody, Massachusetts, U.S.A. Eng. Pat. 4769, April 17, 1885. 8d.

THIS invention relates to the construction of thermometric apparatus in which a pointer is moved by the tension of a helical spring or coil composed of two metals of unequal expansibility. The improvements described consist of an arrangement by which the helical coil is brought parallel to the pointer and not at right angles as heretofore: of a holding device for the coil whereby the effective length of the coil may be adjusted, so that the sensitive helical coils of any number of instruments may be easily regulated to give the same amount of movement to the pointer, although the coils themselves are not exactly uniform in size; of an adjusting device for regulating the position of the helical coil in relation to other parts of the instrument, that the pointer may readily be set at any graduation on the dial for a given temperature. Provision is also made for registering maximum and minimum temperatures by means of free secondary pointers working upon a dial, preferably of smaller diameter than that which co-operates with the main pointer.—W. D. B.

* Any of these specifications may be obtained by post, by remitting the cost price, plus postage, to Mr. H. Reader Lark, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. The amount of postage may be calculated as follows:—

If the price does not exceed 8s.	4d.
Above 8s., and not exceeding 1s. 6d.	1d.
1s. 6d., ..	2s. 1d.
2s. 4d., ..	3s. 1d.
	2d.

Improvements in Arrangements for Use in Oxygenating Water contaminated with Organic Matter. W. F. B. Massey-Mainwaring and J. Edmunds, London. Eng. Pat. 14,807, Dec. 2, 1885. *Sd.*

THE water to be treated is introduced into a well divided in the centre by a partition, on one side of which the water enters and on the other side leaves the well by a suitable passage. Air is blown into the water at the deepest part of the incoming column of liquid, and under the pressure due to the head of water is dissolved, oxidising the impurities, the excess escaping at the surface of the outgoing column. The same thing may be effected by substituting for the open columns of water a stack of tortuous or coiled pipes, at the base of which the air is injected. In all cases the head of water should be from forty feet upwards.—C. C. H.

Improvements in Apparatus for Separating Dust or Solid Particles suspended in Air or other Gases. H. Simon, Manchester. Eng. Pat. 14,905, Dec. 4, 1885. *Sd.*

THE inventor effects the separation of dust or small solid particles from air, by causing the air to ascend slowly through a chamber, in which are arranged one above another, layers or rows of bars, grids, or channels, with

particles by means of subsidence, the rapidity of such subsidence depends directly upon the vertical depth of the liquid. The time taken for the separation being proportional to the depth, the shallower the depth the quicker the operation. In their invention advantage is taken of this rule by applying it to apparatus with extended shallow depositing surfaces provided within a limited space. The accompanying figures, which give three views of one arrangement of the apparatus, will make its action clear.

The tank A is shown raised from the ground, the end D forming a store chamber for the clarified liquid. The bottom of the tank is shaped hopper-like, into which the deposit sinks after separation, and it has a longitudinal opening below closed by a hollow cylindrical valve F, which can be turned by the hand wheel G and worm, for the periodical discharge of the deposit. Any other suitable discharging device may be used instead.

An inclined partition C is provided not far from one end of the tank, reaching from the top to near the bottom, and behind it is a series of inclined smooth plates H H, parallel to C and also kept clear of the bottom, but made water-tight at the sides. The inclination of the sides is such as to allow the deposit to slide down easily and to

FIG. 1.

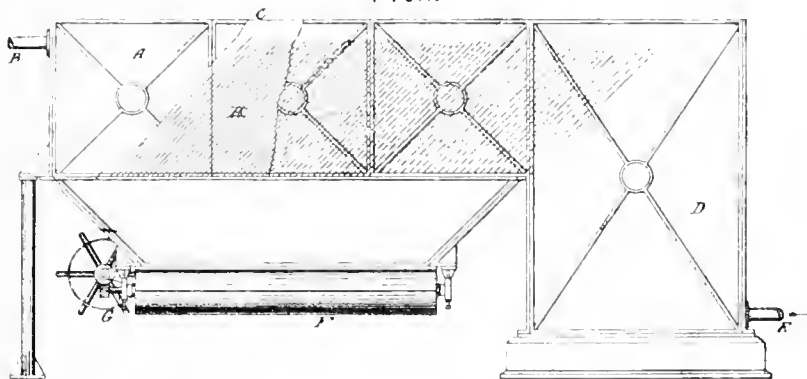


FIG. 2.

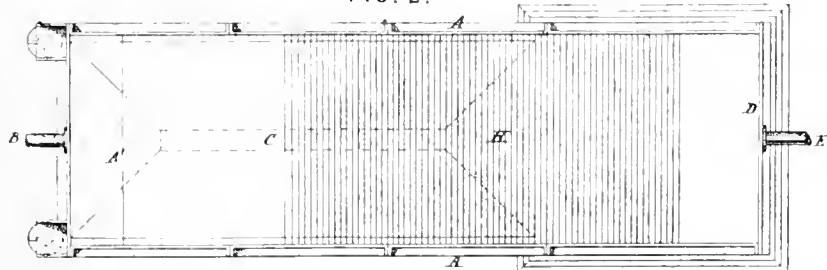
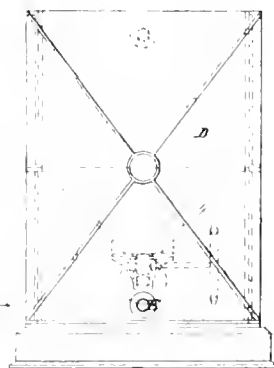


FIG. 3.



small intermediate spaces between them for the passage of the air. The disposition is such as to allow the bare or passages to alternate in adjacent layers. The layers are by preference made higher in the middle of the chamber than at the sides, forming peaks along the centre, for the purpose of allowing the separated dust to slide down the inclined bars or channels, and collect in common receptacles at their ends, whence it may be removed in any convenient manner. The bars may receive a reciprocating movement in their longitudinal direction, or brushes may be made to travel over them with the view to accelerating the collection of the dust, which may be further assisted by the application of an exhaust at the delivery end of the channels. The specification describes some modifications.—B.

Improvements in Subsidence Apparatus. S. H. Johnson, and C. C. Hutchinson, Stratford, Essex. Eng. Pat. 15,713, Dec. 21, 1885. *Sd.*

THE inventors state that they have found, when treating torpid liquids for the separation of their suspended solid

reach the hopper without disturbance. The torpid water enters by the pipe B, sinks down behind the partition C, and slowly rises from below into the spaces between the inclined plates, its speed on rising being regulated to less than the rate of subsidence, which is easily ascertained for various liquids by trial. The cleared water falls finally over the last partition into the reservoir D, and is drawn off by the pipe E.—B.

II.—FUEL, GAS, AND LIGHT.

Experiments with Coal used for Gas Making. H. Bunte. Dingl. Polyt. J. 262, 141.

CONTRARY to the assumption that the elementary analysis of coal offers but little information concerning the value of coal for gas-making purposes, it is shown by experiment that the chemical composition of coal and the most essential factors which engage the attention of the gas maker, are intimately related to one another. As a characteristic constituent of gas coal, oxygen is mentioned, reference being made

to its influence on the quantity and quality of the gaseous and fluid products of distillation. That it is possible to form a definite or valuable judgment of the gas-making properties of a coal from the elementary analysis, is shown by the results of a series of experiments made by the Paris Gas Company at their La Villette testing works. From 1874 to 1884, 1012 experiments were made with 59 different kinds of coal. Each experiment involved the carbonisation of 36,000 kilos. of coal. In addition to the practical analysis, the coal and the products of distillation were subjected to chemical analysis. The constituent oxygen formed the criterion as to the value of each specimen of coal. The quantity varied from 5 to 12 per cent. in the different samples examined. The results arrived at fully confirm the author's views:—(1.) The greater the amount of oxygen present in coal the greater is the quantity of volatile matter, tar and ammonia. (2.) The yield of coke and gas decreases with an increase in the amount of oxygen. (3.) The quantity of hygroscopic water contained in the coal is dependent on the amount of oxygen present therein. With regard to the quantity of benzene contained in coal gas, the results of the Paris Company appear to show that the different varieties of coal yield a gas containing a fairly constant proportion of aromatic hydrocarbons (39grms. of hydrocarbons in 1 cubic metre of gas, of which 30grms. are benzene and 9grms. toluene and its homologues) amounting to 1.05 per cent. In addition to this quantity, the gas contains from 2.5 to 4.8 per cent. of propylene, acetylene and other heavy hydrocarbons. It is also shown that under normal conditions 94 per cent. of the valuable luminosity constituents remain in the gas whilst only about 6 per cent. are present in the tar, a circumstance which proves that the processes which aim at extracting the benzene from tar and restoring it to the gas are of but little practical value.—D. B.

Valuation of Petroleum. C. Engler. Chem. Zeit. 10, 1238—1239, and 1271.

THE author confirms the opinion expressed by Thoenner (this Journal, 1886, 371) that the best methods for determining the value of petroleum as an illuminating agent, are the flashing test and examination of the oil as to its temperature of distillation. For the latter purpose the use of the apparatus described by Thoenner is recommended; the author, however, prefers a glass distillation

9cm., whilst the delivery tube is 10cm. long, 0.6cm. wide, and passes into a copper condensing tube 45cm. long and 1cm. wide.

The ordinary method of distillation does not, however, give concordant results in the hands of different operators; the author therefore recommends the following modification: 100cc. of petroleum are distilled in the above-named apparatus. The distillate boiling up to 150° is allowed to come over at the rate of 2—2½cc. per minute, and when a temperature of 150° has been reached, the flame is removed and the temperature reduced by 20°, after which it is again raised to 150°, this operation of cooling to 130° and heating to 150° being repeated until it is no longer possible to measure the distillate. The fractions boiling up to 200°, 250° and 300° are distilled over in a similar manner. The author objects to limit the distillation to 25—30 minutes, as suggested by Thoenner, owing to the fact that the rate of distillation is dependent on the percentage of distillate obtainable at 300°. He does not approve of extending the limits of the fractionating temperature of normal petroleum (which boils between 150° and 300°) to from 140° to 310° as suggested, being moreover of opinion that the maximum temperature might be reduced to 270° with advantage, especially in the case of Caucasian petroleum, as it has been shown in a recent investigation (this Journal, 1886, 480) that the high boiling fractions have an injurious effect on the illuminating power of petroleum.—D. B.

Improvements in Machinery or Apparatus for the Manufacture of Gas for Illuminating and Heating Purposes. F. W. Clark, London. Eng. Pat. 6511. August 25, 1886. 8d.

GASOLINE or other suitable light hydrocarbon is passed into a heated retort, where it is partly decomposed. The vapour is conducted to a series of impinging points placed opposite to a corresponding series of short tubes, and, rushing through these, creates a partial vacuum whereby air is drawn in to mingle with the hydrocarbon gas. This air is heated on its way by passing in contact with the out-sides of the short tubes above mentioned. The mixed air and hydrocarbon vapour, which has become a practically fixed gas, is passed through horsehair or other scrubbing material placed in a water-cooled vessel.—A. R. D.

Improved Process for Manufacturing Illuminating Gas. A. M. Clark, London. From J. S. Leng, New York. Eng. Pat. 15,768, August 25, 1886. 8d.

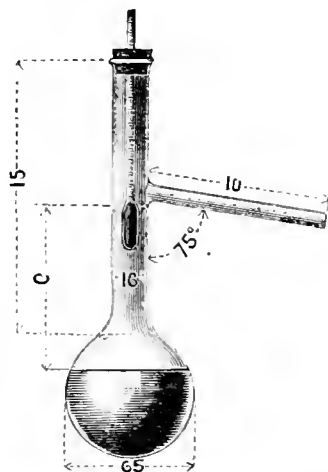
HYDROGEN and carbonic acid are produced by the simultaneous action of dilute acid upon scrap iron and carbonate of lime. The mixed gases are carburetted by being passed through a chamber containing cotton wick saturated with petroleum or other suitable hydrocarbon.—A. R. D.

Improvements in Carburetting Compounds. P. M. Justice, London. From A. P. Rockwell, New York. Eng. Pat. 11,829, Sept. 17, 1886.

THE inventor dissolves 3lb. of gum camphor and 5lb. of vegetable wax in 25 gallons of "benzine" (petroleum spirit) and uses the compound in the same way as other carburetting compounds in any suitable carburetting apparatus. For illuminating gas, Japan-wax is preferred, but for heating purposes "Bay berry wax" is better.—A. R. D.

Improvements relating to the Utilisation of Fuel in a Comminuted Condition, and to Apparatus therefor. H. H. Lake, London. From H. K. Flagler, Boston, U.S.A. Eng. Pat. 15,780, Sept. 22, 1886. 8d.

THIS invention relates to an improvement in the process and apparatus for the utilisation of comminuted fuel referred to in the American patents 53,208 of 1866; 38,577 of 1870; 59,695 of 1866; 102,997, 103,695, 103,804, and 109,785 of 1870; and 111,705 of 1871. By this invention a storage bin is connected by a branch way with the passage whereby the fuel is conveyed from the commi-



flask to the copper distilling flask employed by Thoenner. In recommending the adoption of the conditions of distillation as suggested by Lunge (this Journal, 1884, 513 and 625), the author states that the top of the thermometer bulb should be in a line with the lower edge of the delivery tube, as illustrated in the accompanying drawing. The distance from the top of the charge in the flask (100cc.) to the lower edge of the delivery tube is

nutor to the furnace. By a suitable disposition of valves the comminutor may be made to work either into the furnace direct or into the bin. This latter is provided with a screw which feeds the contents into a shell or casing communicating with the passage to the furnace. Inside the shell works a blower which aids the delivery of the comminuted fuel. The mechanism of the screw-feeder in the bin is quite independent of the comminutor.

—A. R. D.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Some Notes on Gas Liquor and Ammonia Purification.

By Lewis T. Wright. *Journal of Gas Lighting*, 48, 280, 329, 373, and 511.

THIS is a review of what might be expected to take place in ammonia processes for the purification of coal-gas, and, for the purpose of illustrating the reactions involved, the author traces the history of the ammonia resulting from one ton of gas-coal through the various operations of its collection.

For the sake of convenience, the term "hydrogen equivalent" (H.E.) is borrowed from volumetric analysis, but it means, unless otherwise stated, not grammes per litre, but milligrammes simply of the bodies in question, thus—

1 hydrogen equivalent of NH_3 is 17 milligrammes.	
1 " " of CO_2 is 22 " "	
1 " " of H_2S is 17 " "	

And all analyses of liquor are in hydrogen equivalents per 100 cubic centimetres. To convert the hydrogen equivalents into percentages (assuming, for convenience, all the gas liquors to have a specific gravity equal to water), it will be only necessary to multiply them by the following numbers:—0.017 for NH_3 , 0.022 for CO_2 , and 0.017 for H_2S , to have grammes per 100 cubic centimetres, pounds per 10 gallons of the bodies in question, or percentages.

Thus a liquor stated to contain 44 H.E. (hydrogen equivalents) of NH_3 , 21.2 H.E. of CO_2 , and 10 H.E. of H_2S , will be found to contain—

$44 \times 0.017 = 0.748$ grammes. per 100cc., or lbs. per 10 gallons of NH_3 .
$21.2 \times 0.022 = 0.4664$ " " " " " " " " CO_2
$10 \times 0.017 = 0.1700$ " " " " " " " " H_2S

or 0.748, 0.4664, and 0.17 per cent., assuming the specific gravity of the liquor equal to that of water.

This method of stating analyses may appear to be complicated and recondite; but for such a discussion as this is will give a much clearer view of the quality of the liquor. For if it were said that in a certain liquor 0.748 per cent. of ammonia was found in combination with 0.4664 per cent. of carbonic acid, and 0.17 per cent. of sulphuretted hydrogen, no immediate mental picture of the relations of alkali and acids would be given; but if it were said that 44 H.E. of ammonia were found in connection with $21.2 + 10 = 31.2$ H.E. of acids, an immediate idea of its composition would be given, especially when we recollect that 1 H.E. of NH_3 combined with 1 H.E. of H_2CO_3 (or H_2S) gives $(\text{NH}_4)_2\text{CO}_3$ [or $(\text{NH}_4)_2\text{S}$], and 1 H.E. of NH_3 combined with 2 H.E. of H_2CO_3 (or H_2S) gives $(\text{NH}_4)\text{HCO}_3$ [or $(\text{NH}_4)\text{HS}$].

In scrubbing it would be desirable to get the compounds containing 2 H.E. of acid to 1 H.E. of ammonia only; but that, as will be evident later on, is not possible.

The author proceeds to trace the history of the ammonia resulting from the ordinary distillation of a ton of gas-coal for gas-making purposes. The gas liquor condensing between the retort and the condenser equals 13.3 gallons, containing 0.994 "free" ammonia, and having the following composition as regards this constituent, carbonic acid, and sulphuretted hydrogen:—

"Free" NH_3 H.E.	CO_2 H.E.	H.S. H.E.	Total Acids. H.E.	Dif- ference, H.E.	Difference per Cent.	Percentage of Acids as H.S.
44	21.2	10	31.2	-12.8	-29.1	32.05

By "difference" is meant either *plus* or *minus* the number of hydrogen equivalents of acids more or less

than the number of hydrogen equivalents of ammonia. By "difference per cent." is meant the number of hydrogen equivalents of acids more or less than 100 for every 100 H.E. of ammonia present. Thus in the case mentioned above, for every 100 H.E. of ammonia there are 70.9 H.E. of acids, or 29.1 H.E. less than the hydrogen equivalents of ammonia.

The "percentage of acids as sulphuretted hydrogen" will explain itself. Thus, in the case above, for every 100 H.E. of acids, 32.05 H.E. are sulphuretted hydrogen.

The gas, on being cooled in a condenser, deposits 4 gallons of liquor, having the following composition:—

"Free" NH_3 H.E.	CO_2 H.E.	H.S. H.E.	Total Acids. H.E.	Dif- ference, H.E.	Difference per Cent.	Percentage of Acids as H.S.
236.8	189.7	57	246.7	+9.9	+4.2	23.1

This liquor differs widely from the preceding one; but so do the circumstances attending its formation. The one is from hot gas; the other from cold. The variation in composition will become clearer later on. The next operation to which the gas is submitted is a copious washing with gas liquor, consisting of the two previous liquors and that resulting in a fourth washing process shortly to be mentioned, whereby a quantity of ammonia in the "free" condition, equal to 1.939 lb., is recovered. Finally, the gas is washed from any trace of ammonia in a "Standard" washer with clean water, whereby 5.7 gallons, containing 1.012 lb. of NH_3 , having the following composition, are produced:—

"Free" NH_3 H.E.	CO_2 H.E.	H.S. H.E.	Total Acids. H.E.	Dif- ference, H.E.	Difference per Cent.	Percentage of Acids as H.S.
10.4	100.8	26.1	126.9	+22.5	+21.55	20.57

On collecting the liquor at the end of the washing operations, 23 gallons of liquor are obtained, containing 5.553 lb. of "free" ammonia, and of the following composition:—

NH_3 H.E.	CO_2 H.E.	H.S. H.E.	Total Acids. H.E.	Dif- ference, H.E.	Difference per Cent.	Percentage of Acids as H.S.
142.0	136.8	35.5	172.3	+30.3	+21.3	20.6

Summarising the results and inserting the values for the "fixed" ammonia, we have—

	Free NH_3	Fixed NH_3	Free, Per Cent.	Fixed, Per Cent.
13.3 gallons of hydraulic main				
liquor	0.994	0.559	0.748	0.42
4.0 galls. condenser liquor	1.608	0.076	4.02	0.19
scrubber	1.939	0.555		
5.7 " washer	1.012	0.057	1.775	0.10
	5.553	1.247		

Or a total of 6.8 lb. of ammonia per ton of coals.

Continuing the investigation with regard to the carbonic acid and sulphuretted hydrogen removed from the gas by the liquor, and inserting (by difference) the work done by the foul scrubber in respect to these bodies, the results given in Table V. are arrived at.

It must not be understood that a condenser liquor, etc., will always have a composition similar to that stated. Really, the chemical forces regulating the composition are so delicate that apparently trifling differences of temperature and degree of concentration exert considerable influences on the character of a liquor. The same piece of apparatus is continually yielding different qualities of liquor with changes of circumstances; but yet these differences are within certain limits for the same works, because the operations therein conducted vary only within certain limits.

The author examines the composition of the liquor from each of the 10 chambers of the "Standard" washer, as thereby the "growth," so to speak, of gas liquor is capable of very simple illustration. (See Table I.)

Making allowance for experimental errors, it will be noticed that with the concentration of the liquor come: (1) a gradual falling off from 160.42 to 121.55 of hydrogen equivalents of acids per 100 hydrogen equivalents

* Free ammonia is a conventional expression for that portion of the ammonia of gas liquor combined with CO_2 and H_2S .

of ammonia; (2) a gradual falling off of the percentage of acids occurring as H_2S from 53.25 to 20.57 per cent.; and (3) a gradual rise in the fixed ammonia from nil to 6 H.E.

In reviewing these figures, it must be noted that there is one constant condition present—viz., temperature; for there was only 1° F. difference between the inlet and the outlet of the washer. They can be regarded as a case of the influence of concentration on the composition—perhaps a little complicated by variations in the composition of the gaseous mixture in contact; but it is hardly probable that this latter is more than insignificant.

It will be useful to compare the liquor in the fifth and sixth chambers with the liquor collected at the inlet of the condenser (hydraulic main liquor), which occupies a mediate position to them, as regards degree of concentration, and has a very low proportion of acids, and these results with some obtained at a different works

100cc., was heated to 65° C., and agitated, to assist in expulsion of the gases dissociated; then again heated to 80° C.; and, finally, to 85° C.—samples being drawn off at each stage, and submitted to careful analysis. The results are given in Table III.

It is a very common belief that, by prolonged contact of the gas liquor with the gas, the sulphuretted hydrogen can be "pushed out" in favour of the carbonic acid. With our present knowledge it is almost impossible to foretell, at least with any degree of sharpness, what will take place on washing crude gas with a certain sample of gas liquor. Sometimes the carbonic acid will be expelled in favour of sulphuretted hydrogen, and sometimes the reverse phenomenon will occur. It appears to be a question of the equilibrium between three bodies (CO_2 , NH_3 , and H_2S) *vis-à-vis* to four compounds formed by their union (NH_4HCO_3 , $[\text{NH}_4]\text{CO}_3$, NH_4HS , $[\text{NH}_4]\text{S}$)—a case of a base divided

TABLE I.

No. of Chamber.	Free NH_3 , H.E.	CO_2 , H.E.	H_2S , H.E.	Total Acids, H.E.	Difference, H.E.	Difference Per Cent. H.E.	Percentage of Acids as H_2S .	Fixed NH_3 , H.E.
I.....	104.4	100.8	26.1	126.9	+22.5	+21.55	20.57	6.0
II.....	91.6	87.6	21.9	112.5	+20.9	+22.82	22.13	1.0
III.....	76.4	73.6	21.5	98.1	+21.7	+28.10	21.97	2.0
IV.....	62.0	62.8	21.2	84.0	+22.0	+35.18	25.24	2.0
V.....	47.6	46.0	18.1	64.1	+16.5	+31.66	28.23	1.6
VI.....	33.2	32.2	13.2	45.4	+12.2	+36.75	29.07	1.2
VII.....	22.8	19.0	9.4	28.1	+ 5.6	+21.56	33.10	1.2
VIII.....	12.0	10.1	6.15	16.85	+ 1.85	+40.12	38.28	0.8
IX.....	5.8	4.0	3.2	7.20	+ 1.4	+21.11	41.11	0.6
X.....	2.4	1.8	2.05	3.85	+ 1.15	+60.12	53.25	0

TABLE II.

Number of Chamber.	"Free" NH_3 , H.E.	CO_2 , H.E.	H_2S , H.E.	Total Acids, H.E.	Difference, H.E.	Difference Per Cent.	Percentage of Acids as H_2S .
II.....	117.62	111.09	25.49	139.58	- 8.04	- 5.15	18.26
III.....	95.12	90.09	29.26	119.35	+21.23	+25.17	24.32
IV.....	63.32	62.30	21.08	83.38	+18.06	+27.65	25.28
V.....	41.84	41.00	16.46	57.46	+15.62	+37.33	28.61
VI.....	30.12	30.95	13.41	44.39	+13.97	+45.92	30.28
VII.....	19.60	19.5	7.56	27.06	+ 7.46	+38.06	27.91
VIII.....	6.93	10.4	6.58	16.98	+10.05	+ 1	38.75
IX.....	3.67	4.2	1.09	5.29	+ 1.62	+11.11	20.60

NOTE.—The liquor in the tenth chamber was too weak for analysis.

from a washer taking the gas from the outlet of the condensers, and fed with clean water (there being no pumping over of gas liquor). (See Table II.)

With the exception of the seventh, eighth, and ninth chambers, these samples show a very regular and similar falling off of excess of acids and proportion of acids as H_2S . The three last chambers are to be regarded as approximate only, since the quantity taken for analysis being unfortunately small, experimental errors (impossible, under the circumstances, to avoid), would have very great influence. Thus only 0.2cc. of the standard acid was employed for titrating the ammonia in the ninth chamber liquor.

In order to further illustrate the influence of temperature on the composition of liquors, the following case is cited. It is interesting in regard to such proposals as that of Mr. F. C. Hills for the treatment of gas liquor for gas purification processes. Some of the liquor previously described, having 142 H.E. of ammonia per

between two acids complicated by the easy dissociability of the four resultant bodies.

As an instance of the pushing out of carbonic acid by sulphuretted hydrogen in the washing of gas by liquor, the following case is quoted:—One very hot day it became evident that the liquor circulating through a tower foul scrubber was not gaining in strength as regards ammonia. It could not be "got up." Repeated and most careful analyses were made of the liquor on the inlet and outlet of the scrubber, and these results were brought out:—

	"Free" NH_3 , H.E.	CO_2 , H.E.	H_2S , H.E.	Total Acids, H.E.	Difference, H.E.	Difference Per Cent.	Percentage of Acids as H_2S .
In...	104.12	95.80	29.06	124.86	+20.74	+19.92	23.3
Out...	104.30	94.33	33.70	128.03	+23.73	+22.75	26.3

Temperature of scrubber, 60° Fahr.

With so low (for the degree of concentration) total acids, it was to be expected that the relative quantity of these to ammonia might be increased. The temperature was too high to admit of absorption of more ammonia; but the sulphuretted hydrogen increased, and this partly at the expense of the carbonic acid.

A fortnight later (the weather being much cooler in the meanwhile), the strength began to "get up;" and samples from the inlet and outlet gave the following results:—

	"Free" NH_3 H.E.	CO_2 H.E.	H_2S H.E.	Total Acids H.E.	Difference H.E.	Difference per Cent.	Percentage of Acids as H_2S .
In. ...	121.0 ..	120.8 ..	39.2 ..	160.0 ..	+39.0 ..	+32.2 ..	24.5
Out. ...	122.6 ..	120.0 ..	38.7 ..	158.7 ..	+36.1 ..	+29.4 ..	24.4

Temperature of scrubber, 71 Fahr.

there are given in the table below analyses of average samples taken at different periods:—

	"Free" NH_3 H.E.	CO_2 H.E.	H_2S H.E.	Total Acids H.E.	Difference H.E.	Difference per Cent.	Percentage of Acids as H_2S .
Feb.	153.0 ..	127.6 ..	35.5 ..	163.1 ..	+30.1 ..	+22.6 ..	21.8
July	124.6 ..	119.2 ..	35.0 ..	154.2 ..	+29.7 ..	+23.8 ..	22.7
Oct.	112.3 ..	111.2 ..	37.0 ..	148.2 ..	+35.9 ..	+32.0 ..	25.0

The composition of monthly average deliveries of gas-liquor from three works (A, B, and C), as regards free, fixed, total ammonia, and percentage of total ammonia represented by each degree Twaddel is given in Table VI. But to make the difference with different seasons more observable, the diagram on page 659 has been prepared; and it will be seen therefrom how, in spite of the

TABLE III.

	NH_3 H.E.	CO_2 H.E.	H_2S H.E.	Total Acids. H.E.	Difference. H.E.	Difference per Cent.	Percentage of Acids as H_2S .
Original liquor	142.0	136.8	35.5	172.3	+30.3	+21.3	20.6
Heated to 65°	139.5	135.2	27.3	162.5	+23.0	+16.5	16.8
" " 80°	135.0	111.8	27.6	139.4	+4.1	+3.3	19.8
" " 85°	126.5	83.8	25.1	108.9	-17.6	-13.9	23.0
H.E. lost in heating to 85° ..	15.5	53.0	10.4	63.4	+47.9	+509.0	16.4
Loss of each constituent) percent	10.92	38.74	29.29	—	—	—	—

TABLE IV.

TABLE FOR THE CONVERSION OF VOLUME PERCENTAGES OF CO_2 , H_2S , AND NH_3 INTO GRAINS PER CUBIC FOOT OF GAS.

H_2S		CO_2		NH_3		H_2S		CO_2		NH_3	
Percent- age Vol.	Grains per Cubic Foot.	Percentage Vol.	Grains per Cubic Foot.	Percentage Vol.	Grains per Cubic Foot.	Percent- age Vol.	Grains per Cubic Foot.	Percentage Vol.	Grains per Cubic Foot.	Percentage Vol.	Grains per Cubic Foot.
0.1	0.63	0.1	0.81	0.1	0.31	1.6	10.07	1.6	13.03	1.6	5.04
0.2	1.26	0.2	1.63	0.2	0.63	1.7	10.70	1.7	13.85	1.7	5.35
0.3	1.89	0.3	2.44	0.3	0.94	1.8	11.33	1.8	14.66	1.8	5.67
0.4	2.52	0.4	3.26	0.4	1.26	1.9	11.96	1.9	15.48	1.9	5.98
0.5	3.15	0.5	4.07	0.5	1.57	2.0	12.59	2.0	16.29	2.0	6.30
0.6	3.78	0.6	4.89	0.6	1.89	2.1	13.22	2.1	17.11	2.1	6.61
0.7	4.41	0.7	5.70	0.7	2.20	2.2	13.85	2.2	17.92	2.2	6.92
0.8	5.04	0.8	6.52	0.8	2.52	2.3	14.48	2.3	18.73	2.3	7.24
0.9	5.67	0.9	7.33	0.9	2.83	2.4	15.11	2.4	19.55	2.4	7.55
1.0	6.30	1.0	8.15	1.0	3.15	2.5	15.74	2.5	20.36	2.5	7.87
1.1	6.93	1.1	8.96	1.1	3.46	2.6	16.37	2.6	21.18	2.6	8.18
1.2	7.55	1.2	9.77	1.2	3.78	2.7	17.00	2.7	21.99	2.7	8.50
1.3	8.18	1.3	10.59	1.3	4.09	2.8	17.63	2.8	22.81	2.8	8.81
1.4	8.81	1.4	11.40	1.4	4.41	2.9	18.26	2.9	23.62	2.9	9.13
1.5	9.44	1.5	12.22	1.5	4.72	3.0	18.89	3.0	24.44	3.0	9.44

The weather on the few days previously had been cooler even than on the day the sample was taken. Here there is an appreciable gain of ammonia, but a loss of acids. It would seem that gas-liquor is never in equilibrium, it being, as regards composition, in a continual state of unrest.

To illustrate the broad influence of seasons on the whole product of gas-liquor as sent from a gas-works,

larger proportionate washing surface in summer than in winter, the strongest liquor is procured when the weather is cold. This diagram emphasises the influence of temperature on the concentration of gas-liquor.

The value of each degree Twaddel in terms of the percentage of ammonia will be interesting to those who sell their gas-liquor on the hydrometer basis. This value (called the "factor") generally rises and falls with the

TABLE V.

Quantity of Carbonic Acid and Sulphuretted Hydrogen removed from Gas by Ammoniacal Liquor.

Position.	Galls.	"Free" NH ₃ H.E.	CO ₂ H.E.	H ₂ S H.E.	Total Acids H.E.	Difference H.E.	Difference per Cent.	Per- centage of Acids as H ₂ S.	Lbs. "Free" NH ₃ .	Lbs. "Fixed" NH ₃ .	Lbs. CO ₂ .	Lbs. H ₂ S.
On the condenser inlet .	13.3	11.00	21.20	10.00	31.2	-12.80	-29.1	32.05	0.994	0.559	0.620	0.226
Condenser	1.0	236.80	189.70	57.00	216.7	+ 9.90	+ 1.2	23.1	1.608	0.076	1.669	0.388
Washer	5.7	101.40	100.80	26.10	126.9	+22.50	+21.55	20.37	1.012	0.057	1.264	0.253
Foul scrubber .....	.	52.26	66.56	11.01	80.6	-28.1	-51.2	17.42	1.939	0.555	3.368	0.521
Total product	23.0	112.00	136.86	35.50	172.3	+20.50	+21.3	20.60	5.553	1.247	6.922	1.388

TABLE VI.

Monthly Averages of Analyses of Ammoniacal Liquor delivered from Three Gas-Works—A, B, and C.

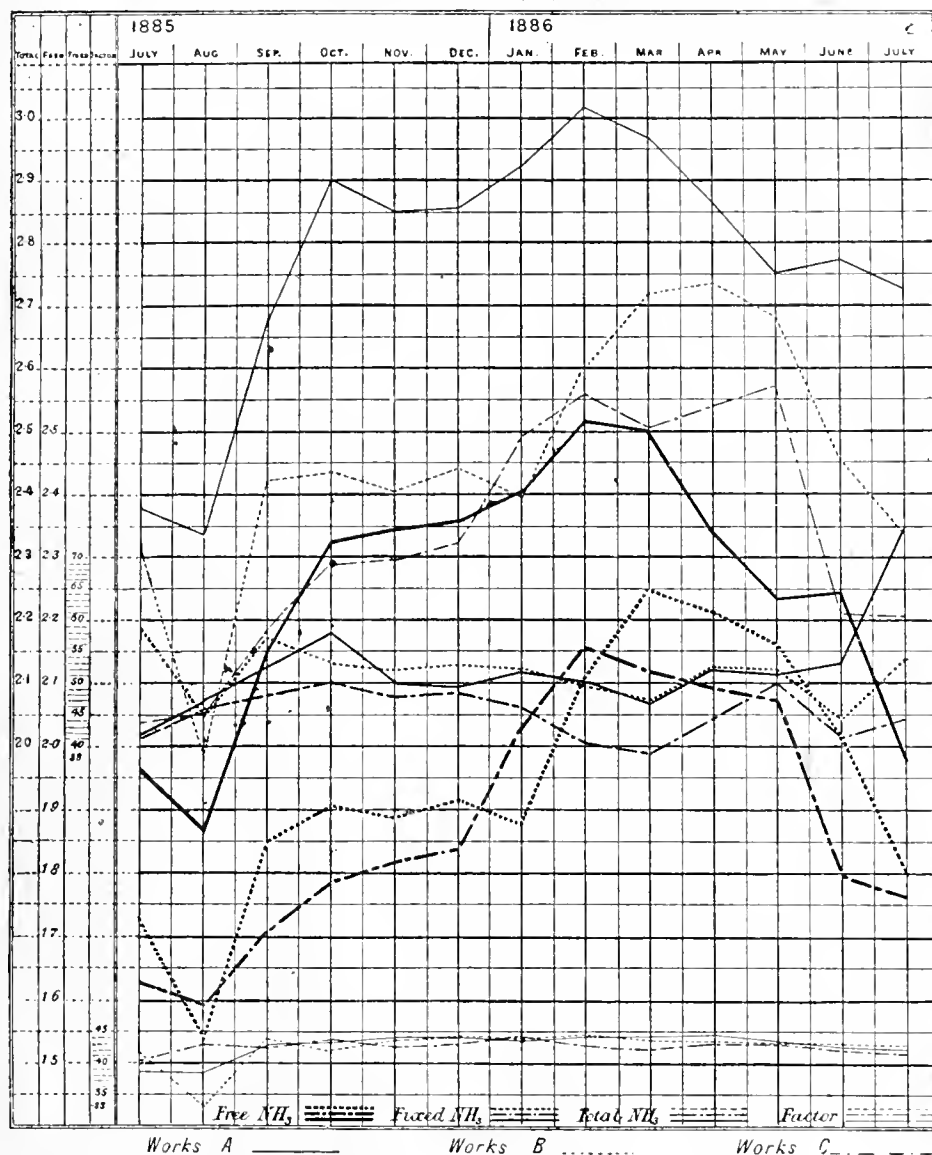
Date.	WORKS A.						WORKS B.					
	No. of Tests.	Mean. Twad.	Free NH ₃ .	Fixed NH ₃ .	Total NH ₃ .	Factor.	No. of Tests.	Mean Twad.	Free NH ₃ .	Fixed NH ₃ .	Total NH ₃ .	Factor.
		Deg.	Per ct.	Per ct.	Per ct.			Deg.	Per ct.	Per ct.	Per ct.	
July, 1885.....	17	6.12	1.957	.420	2.377	.388	12	5.54	1.723	.586	2.309	.417
Aug. ".....	7	6.01	1.861	.471	2.335	.386	1	6.00	1.543	.448	1.991	.332
Sept. ".....	16	6.24	2.150	.525	2.675	.429	9	5.52	1.851	.571	2.422	.439
Oct. ".....	16	6.70	2.323	.579	2.902	.433	15	5.81	1.905	.531	2.436	.419
Nov. ".....	22	6.17	2.319	.501	2.850	.410	18	5.51	1.886	.519	2.405	.436
Dec. ".....	14	6.49	2.359	.495	2.851	.410	12	5.52	1.914	.528	2.442	.442
Jan., 1886.....	17	6.69	2.402	.518	2.920	.436	11	5.46	1.877	.521	2.398	.439
Feb. ".....	21	6.80	2.513	.502	3.015	.443	14	5.83	2.110	.492	2.602	.416
March ".....	25	6.72	2.560	.469	2.969	.442	12	6.28	2.249	.470	2.719	.433
April ".....	23	6.45	2.341	.523	2.861	.444	14	6.31	2.212	.524	2.736	.434
May ".....	16	6.29	2.234	.513	2.747	.437	9	6.18	2.161	.521	2.682	.431
June ".....	5	6.48	2.243	.531	2.774	.428	5	5.70	2.011	.444	2.455	.431
July ".....	7	6.44	1.980	.745	2.725	.423	8	5.44	1.800	.536	2.336	.429

Date.	WORKS C.					
	No. of Tests	Mean Twad.	Free NH ₃ .	Fixed NH ₃ .	Total NH ₃ .	Factor.
		Deg.	Per ct.	Per ct.	Per ct.	
July, 1885.....	23	5.02	1.626	.411	2.037	.406
Aug. ".....	10	4.77	1.594	.458	2.052	.430
Sept. ".....	12	5.12	1.705	.478	2.183	.426
Oct. ".....	26	5.23	1.786	.501	2.287	.437
Nov. ".....	22	5.39	1.818	.477	2.295	.426
Dec. ".....	18	5.40	1.838	.484	2.322	.430
Jan., 1886.....	23	5.65	2.031	.461	2.492	.441
Feb. ".....	18	5.98	2.156	.404	2.560	.428
March ".....	6	5.93	2.116	.389	2.505	.422
April ".....	46	5.90	2.095	.446	2.541	.431
May ".....	40	5.96	2.074	.500	2.574	.432
June ".....	31	5.25	1.797	.412	2.209	.421
July ".....	16	5.29	1.762	.442	2.204	.417

concentration of the liquor. It is too long a matter to go into the variations in the fixed ammonia. Enough has been said to suggest that though gas-liquor is a variable, sensitive sort of liquid, its variations are governed by laws, and is controlled by the action of chemical forces not so occult as to be undiscoverable. As it is often convenient to know the weights of quantities of H_2S , CO_2 , and NH_3 , when expressed in percentage by volume, Table IV. is inserted (page 657), calculated on the basis of 760mm. bar. and 15.5°C . These standards approximate so closely to the English ones

This is started with 23 gallons of gas-liquor, containing 5.553lb. of NH_3 combined with 6.922lb. of CO_2 and 1.388lb. of H_2S , and 1.247lb. of NH_3 combined with stronger acids, requiring for their liberation the assistance of a stronger base. It is assumed that the whole of these 6.8lb. of ammonia can be recovered in the caustic form; and by what means it can be so causticised is a matter of indifference at the moment, the commercial aspect of the question at this stage of the inquiry being purposely eliminated. It can be done by distillation with excess of lime. The gas-liquor is perfectly useless

DIAGRAM showing the Monthly Averages of Analyses of Ammoniacal Liquor delivered from Three Gas Works—A, B, and C.



(30in. bar. and 60°Fahr.) that it can be used with them.

The author refers to the past and present interest in ammonia purification processes, and declines to discuss either the Claus or Hammond process for want of sufficient information respecting these. The chances of ammonia purification are examined on theoretico-practical grounds, and the first case imagined will be the simplest expression we can give to such a method.

First Case.—The problem is to remove from the gas resulting from the distillation of one ton of gas-coal the whole of the carbonic acid and sulphuretted hydrogen,

in its ordinary form. With these 6.8lb. the coal-gas is to be washed at a stage immediately later than the ordinary scrubbing or washing that resulted in the production of the 23 gallons of gas-liquor. The liquor containing the causticised ammonia is called the "regenerated liquor," and would have 173.88 H.E. of caustic ammonia, or $173.88 \times 0.017 = 2.956\text{lb.}$ per 10 gallons. Since a liquor of this degree of ammonia concentration could probably not, in an ordinary way, combine with more than 110 H.E. of acids per 100 H.E. of ammonia, it is proposed to consider it as being diluted down so as to have a concentra-

tion of 142 H.E. This dilution can take place in the regeneration; and this because it is desired to retain a liquor of that degree of concentration as a type. The gas representing one ton of coals is supposed to contain 14.5 lb. of H_2S and 21.5 lb. of CO_2 at the commencement of the ammonia purification process.

Considering a hydrogen equivalent as equal to 0.0017 lb. of NH_3 , 0.0022 lb. of CO_2 , and 0.0017 lb. of H_2S , as it would be if the analyses were stated in pounds per gallon. We shall then have—

$$\begin{aligned} \frac{6.8}{0.0017} &= 4000 \text{ H.E. of } \text{NH}_3, & \frac{21.5}{0.0022} &= 9773 \text{ H.E. of } \text{CO}_2, \\ \frac{14.5}{0.0017} &= 8529 \text{ H.E. of } \text{H}_2\text{S}. \end{aligned}$$

or 4000 H.E. of ammonia and 18,302 H.E. of total acids. Further, assuming that the relation of 142 H.E. of ammonia to 172.3 H.E. of total acids will still be maintained through all the liquors obtained in the purification process, that the 4000 H.E. of ammonia can always be "regenerated" without loss, and that there will be no interference by the combination of some of the ammonia with bodies other than sulphuretted hydrogen and carbonic acid—in other words, that there will be no accumulation of fixed ammonia—the question is asked, *How many times will it be necessary to regenerate our 4000 H.E. of ammonia to remove from the gas 18,302 H.E. of acids?* The answer is 3.77 times; thus—

$$\frac{142 \times 18,302}{172.3 \times 4000} = 3.77 \text{ nearly.}$$

This purification is traced by steps in order to discover the composition of the gas as regards carbonic acid and sulphuretted hydrogen after each washing with the regenerated ammonia:—

Quantities of CO_2 and H_2S remaining in the Gas after each Washing with Regenerated Ammonia.

Before washing	21.5	lb. CO_2 ..	14.5	lb. H_2S .
After 1st washing	13.024	"	12.801	"
After 2nd washing	4.548	"	11.102	"
After 3rd washing	nil.	"	6.367	"
After 4th washing with 77 p.c. unregenerated ammonia	nil.	"	nil.	"

Thus arriving at the same result.

Since the causticisation of the gas-works ammonia by purely chemical methods (such as its replacement by some other alkali) is quite out of the question for an ammonia purification process, men have been led to consider other means of effecting this object—strictly mechanical means suggested by the property the compounds of ammonia with carbonic acid and sulphuretted hydrogen respectively have of being readily dissociated by heat. The weak chemical affinity possessed by these compounds, and the comparative ease with which the three bodies can be brought into a free gaseous condition, together with their varying solubilities in water, form the basis of a method for the separation of the alkali from the objectionable acids. The author thinks that Hills was the first to attempt the causticisation of the ammonia of gas-liquor for purification by the simple heating of the liquor, but is not aware that the behaviour of the liquor under these circumstances has been copiously studied; but a broad fact was recognised by Hills—namely, that the application of a certain degree of heat to gas-liquor resulted in the expulsion of comparatively more of the acids (CO_2 and H_2S) than the ammonia; and that, consequently, a liquor so treated contained less of these acids in proportion to its content of ammonia than it did before being submitted to this operation of heating.

Armed with these two generalisations—(1) that heat causes a dissociation of the principal ammonium compounds of gas-liquor into free NH_3 , CO_2 , and H_2S respectively; and (2) that ammonia gas is much more soluble in water than carbonic acid and sulphuretted hydrogen gases respectively—it is possible to conceive a method for the separation of the more readily soluble ammonia from the less soluble acid gases. Further, if (1), at a moderate temperature in the presence of water, the dissociation of the ammonium salts in question were complete, and (2), conversely, at the said moderate tem-

perature, it were only a question of the absorption coefficients of the ammonia, carbonic acid, and sulphuretted hydrogen in water, uncomplicated by the play of any chemical affinities (the dissociation in the presence of water being assumed as complete), the causticisation of the gas-works ammonia for practical purposes would be comparatively simple. But it unhappily occurs that no moderate heating short of boiling and consequent expulsion of the constituents of gas-liquor results in the complete dissociation of the compounds of ammonia with carbonic acid and sulphuretted hydrogen contained therein. That anything more than a very partial causticisation of the ammonia of gas-liquor is possible by Hills' process must be admitted.

It was previously shown that a liquor of the composition—

"Free" NH_3 H.E.	CO_2 H.E.	H.S. H.E.	Total Acids, H.E.	Differ- ence, H.E.	Differ- ence per cent.	Percentage of Acids as H.S.
142.0	126.8	35.5	172.3	+30.3	+21.3	20.6

on heating to 85° C., with agitation, was left with a composition of—

"Free" NH_3 H.E.	CO_2 H.E.	H.S. H.E.	Total Acids, H.E.	Differ- ence, H.E.	Differ- ence per cent.	Percentage of Acids as H.S.
126.5	83.8	25.1	108.9	-17.6	-13.9	23.0

This residual liquor would be of considerable value as a purificatory agent, as, with a difference per cent. of -13.9, it might, by contact with coal-gas, be readily brought up to a difference per cent. of +21.3. On this basis each gallon would be able to put on 44.6 H.E.; and as there are 18,302 H.E. of total acids in the crude coal-gas to be purified per ton of coal after the usual washing process, it would be necessary to treat the gas with—

$$\frac{18,302}{44.6} = 410 \text{ gallons (nearly)}$$

of this partially "regenerated" liquor for complete purification; or the 23 gallons would have to be submitted to Hills' process—

$$\frac{410}{23} = 17.8 \text{ (nearly)}$$

—say, about 18 times. This may sound a good many; but it would not be at all a serious matter to raise 410 gallons of gas-liquor to 85° C., and, after agitation, to cool it to normal temperature for every ton of coals carbonised; and it is difficult to think why Hills' process has not met with more success. In connection with a sulphate works, where the gases expelled on the heating of the liquor could be passed through an acid saturator for the manufacture of sulphate, the system would be simple. Agitation to assist expulsion of gases from the heated liquor would be a great feature in such a process.

For an argument of this kind, a higher temperature than 85° C. might have been selected, resulting in the production of a liquor containing, relatively to the ammonia present, a lesser proportion of total acids, and capable of removing per gallon a larger number of hydrogen equivalents of impurities from the gas to be purified. However, the instance cited will serve to illustrate one form of an ammonia purification process.

The author does not believe that any high degree of causticisation of gas-liquor by Hills' process is attainable. But until more definite information is forthcoming, it will be quite natural that great things should be expected of a method founded upon some system of fractional distillation, wherein the gases were expelled from the gas-liquor and the ammonia continuously washed back with as little as possible of the objectionable acids. But having obtained by any means a caustic liquor, it is in the highest degree improbable that any advantage can result by its final distillation, with a view of expelling its ammonia into the coal-gas to be purified in a gaseous condition, rather than using the caustic liquor direct for the treatment of the coal-gas. For all practical purposes of gas purification, when, by a process of fractionation, a caustic liquor can be secured, it will be sufficient to use it forthwith; for, that there are any magical results attending the application of a certain quantity of caustic ammonia to the coal-gas to be purified, simply

because it is in the gaseous condition, and not dissolved in water at the time of its introduction, the author does not believe.

The fractionation of the constituents of gas-liquor is a matter of great importance; but it is hard to call to mind a case of fractionation in every respect similar to the one at present under discussion.

Mallet's proposed process for the preparation of a concentrated oxygen from the atmosphere is referred to as an interesting case of the more or less perfect separation of the two constituents of atmospheric air.

The separation of the constituents of mixed liquids by fractional distillation, though in many instances a matter of ease, in other cases is impossible. Many mixtures of liquids—like a solution of hydrochloric acid, consisting of 79.8 per cent. of water and 20.2 per cent. of HCl—distil unchanged as a homogeneous liquid, and cannot be separated by fractional distillation. The disengagement of ammonia from carbonic acid and sulphuretted hydrogen is a case complicated by chemical affinities which come prominently into play at certain temperatures. Given a gaseous mixture of the three bodies in question, the differentiation of the ammonia from the other two is not an easy matter. Any attempt at separation by washing with water will result in a solution containing each of the three bodies. One cannot dissolve the ammonia without also dissolving some of the acids, with the formation of ammonium compounds. The first gases coming off a gas-liquor submitted to distillation are relatively to the liquor poor in ammonia and rich in acid gases; but as the distillation proceeds the gases become relatively richer and richer in ammonia.

By referring to the case of the liquor submitted to 85° C. with agitation (above-mentioned), the gases expelled had the constitution—

NH ₃ H.E.	CO ₂ H.E.	H ₂ S H.E.	Total Acids. H.E.	Difference H.E.	Difference per cent.	Percentage of Acids as H ₂ S.
15.5	53.0	10.4	63.4	+47.9	+309.0	16.4

In washing such a gas with water to arrest the ammonia a large quantity of acid gases must escape; but a caustic liquor is not thereby produced.

On pushing the liquor to distillation, and collecting successive portions of the distillate, liquors of the following composition were obtained:—

	NH ₃ H.E.	CO ₂ H.E.	H ₂ S H.E.	Total Acids, H.E.	Difference, H.E.	Difference per cent.	Percentage of Acids as H ₂ S.
First 10th of liquor over	577.0	622.0	118.2	740.2	+163.2	+28.3	15.5
Second do.	259.0	110.0	25.4	135.4	-123.6	-47.7	18.9
Third do.	84.5	7.0	10.1	17.1	-67.4	-80.0	59.0

Of 1420 H.E. of ammonia taken, 259 H.E., or 18.24 per cent., are recovered in connection with -47.7 difference per cent. of total acids, and 84.5, or 5.95 per cent., with -80 difference per cent. of total acids.

Now, if it were sought to secure a liquor containing only 20 H.E. of total acids per 100 H.E. of ammonia, it would be only possible to get on the first distillation—

$$\frac{84.5 \times 100}{1420} = 5.95 \text{ per cent.}$$

of the ammonia in the required condition; and the balance would have to be successively distilled and re-distilled till the whole of the ammonia was brought to the required degree of causticity. Of course, in a process of fractionation, these successive distillations would really form part of a continuous process.

Until further information is forthcoming, judgment as to the relative values of Hills' and Claus' methods of ammonia purification must be suspended.

On the Earth-Oil of Baku. Dingl. Polyt. J. 262, 47.

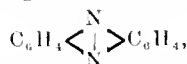
PROFESSOR D. J. MENDELEJEFF, who has been commissioned to study this industry on the spot, in a communication to the Russian *Zeitschrift Technik*, 1886, No. 109, says that the mode of working Baku oil is different from the method usually adopted in America, on account of the difference in composition. In his

experiments, he succeeds in obtaining 50 per cent. light oil, instead of the 30 per cent. hitherto obtained. It is known as "Bakuol," burns well, and compares favourably with the American product in every respect. The naphtha residues also now possess a higher value, and are not merely used for fuel as hitherto. The "Bakuol," mixed with 30 per cent. of tar-oil and other products, is known to the Petersburg Chemical Society as "Ragasin," and can be burnt in various lamps with the best results. He does not fear the exhaustion of the oil-springs in the near future, it being simply necessary to bore deeper for fresh supplies. In the neighbourhood of Baku, 5 parts of the sand contain 1 of naphtha. According to geological examination the naphtha-bearing layer has a thickness of several metres.—W. R.

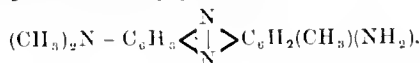
IV.—COLOURING MATTERS AND DYES.

On Phenazine. A. Bernthsen. Chem. Zeit. 10, 1241.

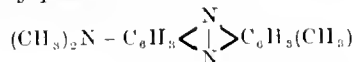
THE author makes some interesting statements concerning the chromogenic character of the compound



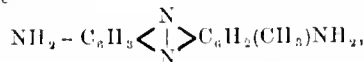
which has been termed phenazine by Merz, who has also established its identity with the azophenylene described by Claus. It is shown that Witt's toluylene-red is *dimethyldiamidomethyl-phenazine*



By removing one amido group with N₂O₅, *dimethylamidomethyl-phenazine*



is obtained. This substance resembles erubidine in properties. It forms red prisms exhibiting a fine gold-coloured fluorescence in ethereal solution. The simplest toluylene-red obtained from metatolylenediamine and paraphenylenediamine proved to be *diamidomethyl-phenazine*



as by diazotising it the author obtained *methyl-phenazine*, a body which Merz had previously prepared by heating catechol with orthotolylene diamine.—D. B.

Improvements in the Manufacture of Colouring Matters for Dyeing and Printing. H. Hassenkamp and the "Farbenfabriken vorm. F. Bayer & Co.," Elberfeld, Germany. Eng. Pat. 15,337, Dec. 14, 1885. 6d.

THE object of this invention is to supply colours which can be used as cheap substitutes for certain indigo preparations. The materials employed are the nitroleuco-bases obtained by the condensation of metanitrobenzaldehyde with alkyl-derivatives of aniline (E. & O. Fischer, Ber. 12, 802) and the amidoleuco-bases obtained by their reduction. In the present process benzyl groups are introduced into these amidoleuco-bases, and the benzyl derivatives are converted into sulphonic acids, and the latter then oxidised to acid colouring matters of a bluish green shade. As examples of materials the authors mention the amidoleuco-bases obtained by reducing the condensation products of metanitrobenzaldehyde with mono- and dimethylaniline, mono- and diethylaniline, methyl- and ethylbenzylaniline, etc. It is stated that with these materials the benzyl groups contain the sulpho groups. The following illustration of the practical working of the process is given. The amidoleuco-base, NH₂.C₆H₄.CH : [C₆H₄.N(CH₃)₂]₂, from metanitrobenzaldehyde and dimethylaniline is first benzylised by being heated in an autoclave with the necessary quantity of benzyl chloride and caustic soda (115° C. for 4–6 hours), and the product is steam-distilled

and dried. The benzylised base is then sulphonated by treatment with five times its weight of fuming sulphuric acid (20–25 per cent. anhydride), the sulphonic acid oxidised by lead or manganese peroxide, and the colouring matter salted out.—R. M.

Improvements in the Manufacture of Colouring Matters. C. Rudolph, Höchst, and Oscar Gürke, Elberfeld, Germany. Eng. Pat. 15,716, Dec. 21, 1885. 6d.

THIS specification relates to the production of naphthalenetrisulphonic acid and naphtholdisulphonic acid, and the colours derived therefrom. Naphthalene is gradually introduced into eight times its weight of fuming sulphuric acid (24 per cent. anhydride), and the mixture kept at 180° C. for several hours, or six parts of acid containing 40 per cent. of anhydride can be used, keeping the temperature down to 80° during mixture, and then heating on a water-bath. The product is limed, and the calcium salt converted into one of sodium. Instead of naphthalene, its mono- or disulphonic acid may be employed, and sulphonation may also be effected by means of sulphonic chloride, sulphuric acid and sodium pyrosulphate, sulphuric and metaphosphoric acids, etc. The sodium salt, prepared as above, may be used directly, or it may, if required, be purified by fractional crystallisation from water, or by extraction with alcohol (80° Tralles). In order to convert the trisulphonic acid into naphtholdisulphonic acid, the sodium salt is heated in a closed vessel with half its weight of caustic soda, and a similar weight of water. The vessel is heated in an oil bath to 170–180° C. for several hours. The melt contains a mixture of naphtholdisulphonic acids which may be used without separation, or one of the isomerides may be separated in the form of an acid sodium salt, by adding hydrochloric acid and evaporating to the crystallising point. Another method of separation consists in neutralising the melt with hydrochloric acid, evaporating to dryness, and extracting with alcohol (80° Tralles). The inventors mention a number of characters in which their acid differs from the four known naphtholdisulphonic acids of previous patents. The azo-colours are prepared by combining various diazotised bases with the new acid in alkaline solution in the usual way.—R. M.

Improvements in the Production of Colouring Matters or Dyestuffs. C. D. Abel, London. From Carl Roth, Berlin, Germany. Eng. Pat. 43, Jan. 1, 1886. 6d.

THE colouring matters obtained by the oxidation of mixtures of aromatic monamines and paradiamines (Indamines) are well known to be very unstable, and have, therefore, but a limited application in dyeing and printing. According to the present invention, stable colouring matters are produced by oxidising the mixture in the presence of sodium hyposulphite or hypophosphite. Three examples of the mode of preparation of these dyes are given in the specification:—(1.) Dimethylaniline is converted into dimethylparaphenylene diamine, and the hydrochloride mixed with the necessary quantity of aniline hydrochloride, and afterwards zinc chloride and sodium hyposulphite are added. The solution is mixed in the cold with potassium chromate and heated for some time, dilute sulphuric acid and more chromate being added till the oxidation is complete. The colour is finally salted out by adding common salt, and is sent into the market in the form of a double zinc salt. (2.) Dimethylparaphenylene diamine is oxidised as before in the presence of dimethylaniline and sodium hyposulphite. The colour has a greenish blue shade, whereas that obtained in the first example has a reddish blue tint. (3.) "Dimethylphenylene green" is reduced to its leuco-base by means of zinc dust, and then oxidised in the presence of hyposulphite. The colour is identical with that obtained in the last example. Instead of the dialkyl-diamines the paranitroso derivatives of the tertiary amines may be employed. Thus the colouring matter of example 2 can also be obtained by heating a solution of nitrosodimethylaniline and dimethylaniline hydrochlorides with hyposulphite, and then oxidising with chromate as before.—R. M.

An Improved Process for Manufacturing Colour Sensitive (Isoschromatic or Orthochromatic) Photographic Emulsions or Plates by Dyeing the same with Dyes highly sensitive to Light. H. W. Vogel, Berlin, Germany. Eng. Pat. 7963, June 15, 1886. 6d.

THE object of this invention is to make gelatin or other photographic plates sensitive to yellow and red light by the addition of a small quantity of certain dyes. The dyes most suitable are such as are themselves readily decomposed by light. The following formula is suitable for many emulsions:—

2 to 4cc. of a solution of quinoline red in alcohol (1 to 500).
5 drops of a solution of cyanine (1 to 500).
100cc. of water.
1cc. of ammonia.

The plates are steeped in this solution for one minute, and then dried.—E. J. B.

Improvements in the Manufacture of Blue Dyestuffs or Colouring Matters, and in the Method of fixing the same. J. C. Jefferson, Leeds. From G. A. Dahl (Dahl & Co.), Barmen, Prussia. Eng. Pat. 10,134, Aug. 9, 1886. 6d.

THESE colouring matters are obtained by fusing paradiamines with amidoazo compounds or their sulphonic acids. They are soluble in water, and dye mordanted cotton blue which becomes darker on oxidation with potassium bichromate, and is then fast, both as to light and washing. The best results are given by paraphenylene diamine and amidoazobenzene and its homologues. The amidoazo compounds are used in the form of hydrochlorides, or else benzoic acid is added during the fusion. The method of oxidising the colour so as to fix it in the fibre consists simply in passing the dyed goods through a boiling bath containing the oxidising material.—R. M.

Manufacture of Resorcin Blue. O. Murray. From H. M. Baker, Brooklyn, U.S.A. Eng. Pat. 11,356, Sept. 7, 1886.

To prepare this colour, resorcinol is dissolved in excess of aqueous ammonia, and to the solution is added a solution of the double carbonate of ammonium and copper, equal in weight to that of the resorcinol. Into the mixed solutions a revolving copper plate is immersed; this plate or disc being partly in the solution and partly exposed to the air. The conversion into colouring matter takes place slowly at ordinary temperatures, ammonia being added from time to time to replace the loss by evaporation, and to keep the solution alkaline. When the whole of the resorcinol has been converted, the solution is acidulated and boiled, the colouring matter separating out on cooling. The product may be purified, if necessary, by redissolving in ammonia, and reprecipitating by acid. The colouring matter is said to have the formula $C_{14}H_{12}N_2O_6$; it is insoluble in water and dilute acids, but soluble in alkalis with a blue colour, and readily forms lakes. The methyl and ethyl derivatives have a great affinity for cotton. The inventor claims for this colour a value equal to that of the best qualities of indigo, for which, according to the specification, it can be used as a substitute.—R. M.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Contributions to the Theory of Turkey-red Dyeing. P. Lukianoff. Dingl. Polyt. J. 262, 36–44.

EXPERIMENTS carried out to determine the rôle of the fatty substances in Turkey-red dyecol have hitherto led to two distinctly opposite views. Some experimenters attribute a chemical action to the fatty acids in the formation of the Turkey-red lake, others assume that the fatty substances in the form of undercomposed glycerides exercise a physical influence on the ingredients of the lake. These views are not new, they appeared even before the introduction of alizarin oil. The arguments

for these views are not satisfactory, so that at the present time not only is the composition of the Turkey-red lake undetermined, but the real action of the fatty substances in the dyeing process is also unexplained, and the composition of the so-called alizarin oil at present used in preparing the fibre for Turkey-red dyeing is still less known.

The following results may in some measure elucidate this question in its different forms; they show which particular fatty substances are able to assist in the formation of the Turkey-red lake, also what influence one or other of them exercises on the properties of the lake.

Liechti and Suida (see this Journal, vol. iii, p. 412), and other experimenters have shown that in the well-washed oil product obtained by sulphonating fatty substances (which on neutralising with ammonia gives alizarin oil), two different products exist, one soluble in water, the other insoluble, and although their exact composition is not yet known, still it is generally understood that the portion soluble in water contains sulpho-fatty acid compounds, whereas the portion insoluble in water contains no sulphur and consists of distinct acid bodies; indeed, according to Müller Jacobs, neutral fatty substances—i.e., glycerides—are also present, and that too in large quantity. It appears therefore very important to know what effect these two products of the action of sulphuric acid upon oil have upon the formation of the Turkey-red lake. To determine this the author treated the fibre with the soluble and insoluble portions of alizarin oil. The washed product obtained by sulphating castor oil is shaken up with four times its volume of water at the ordinary temperature and allowed to stand. The upper oily layer is decanted off, and on the addition of common salt to the lower aqueous solution an amber-yellow fatty substance is obtained; both products were neutralised with ammonia. The two alizarin oils thus produced are transparent, and give clear solutions on dilution with water, although the product insoluble in water is darker and thicker than the other. The product soluble in water contains four times as much sulphur as the insoluble portion, as shown by the following analysis:—

Alizarin Oil.	Water.	SO ₃ .	Fatty substances and Alkali.
From soluble portion	24.10	15.93	59.97
From insoluble portion	26.10	1.08	69.82

Comparative experiments showed that cotton prepared with the product soluble in water gave the purest and brightest reds, whilst that prepared with the product insoluble in water gave the deepest and most even colour, but it was not so pure, being of a dark-yellowish tone. Trials in which mixtures of the two were employed gave fuller but more yellowish colours, as the portion insoluble in water was increased, a difference no doubt due to the facility with which the product soluble in water is removed in the various operations, as proved by weighing the pieces both before and after the different operations, the piece prepared with the product soluble in water being much lighter than that prepared with the portion insoluble in water. The dyed pieces prepared with the portion insoluble in water withstood the action of soap, alkali acid, and chlorine solutions better than those prepared with the portion soluble in water. It is thus evident that the products have a very different action in the process of Turkey-red dyeing.

Since Müller-Jacobs maintains that the portion insoluble in water chiefly consists of unchanged glycerides, the author also examined the influence of this substance on the lake. The fibre was prepared with different mixtures of the portion soluble in water and castor oil. Similar results were observed as in the previous trial—viz., the increasing quantity of castor oil made the ultimate colour much fuller, but also yellower in tone; moreover the pieces felt more or less fatty. The dyed pieces prepared with the castor oil withstood the action of soap better than the others, in fact the colour was considerably improved by this means. Hence the presence of unchanged glyceride is not prejudicial to the formation of the Turkey-red lake, and it is not improbable that the portion insoluble in water may contain unchanged glycerides, as already expressed by Müller-

Jacobs. From various observations, however, the author concludes that the amount of unchanged glyceride in the product insoluble in water is not particularly important.

From the above trials it would be wrong to ascribe the influence of alizarin oils in Turkey-red dyeing entirely to the presence of unchanged glycerides, and that the portion soluble in water merely acts as a solvent suitable for the transfer of the glycerides to the fibre; on the contrary, the portion soluble in water has a much more important role, since it influences the purity and fire of the red colour. The presence of the unchanged glyceride in certain limited proportions is evidently useful in contributing to the fulness and fastness of the colour, but if present in larger quantity it affects the shade, and a strong clearing is required to restore the colour. This is confirmed by the fact that pieces prepared with alizarin oil made from free fatty acids compare favourably in colour with those prepared with alizarin oil made from glycerides.

The author explains that under the influence of heat the portion soluble in water is evidently changed into oxidised fatty acids, which combine chemically with the alumina, this compound again uniting with alizarin to form the Turkey-red lake. This triple compound is itself fast, but it is improved in fulness, lustre, and evenness by the presence of the neutral glycerides which act physically upon it, producing a lustrous fatty covering, thus preventing the loss of water of hydration, which, according to Müller-Jacobs, has a great influence on the beauty of the colour.

From the above it is not difficult to explain what takes place when preparing the fibre with “huile tournaute”—viz., that the glyceride is decomposed under the influence of alkalis, ferments, and heat, forming oxidised fatty acids. A similar relation exists, therefore, between the two methods of preparing cotton for Turkey-red dyeing, and that the fibre prepared by the older process should feel fatty, and require a more prolonged and stronger clearing, is easily understood. It may be urged against the purely physical theory, that if the oiling in Turkey-red dyeing be simply necessary to transfer the undecomposed glycerides to the fibre, this is attainable by a much simpler means than by the detailed and protracted process employed in the old mode of preparing.

—W. R.

An Improved Method of obtaining Baths of Chloride of Antimony for Use in Dyeing and Calico Printing. G. Watson, jun., Glasgow. Eng. Pat. 15,438, Dec. 15, 1885. 6d.

If antimony be taken in the form of trichloride, and water be added to it in order to obtain a bath of any required strength, basic compounds are formed, unless a sufficient quantity of free acid be present, or be added, and the bath is thereby rendered less efficient or useless. To avoid this, the inventor makes use of an addition of chloride of sodium, dissolved in the water used for dilution, in quantity sufficient to prevent the formation of basic compounds. In place of chloride of sodium, the chlorides of potassium or magnesium, or a mixture of any two or all of them, may be used.—J. H.

Improvements in Dyeing and Printing Aniline Black, and in the Solutions used therefor. B. F. Cresson, Philadelphia, U.S.A. Eng. Pat. 38, Jan. 1, 1886. 6d.

For dyeing aniline black the goods are twice padded in a colouring solution, then dried by running through ageing machine at 140° F., hung 24 hours at 85° F., passed through chrome at 6° Tw., washed and dyed in sumac. For printing aniline black a resist acid is used, the goods after drying being padded on the black machine with the colouring solution, after which they are immediately hung, and kept hanging, as in the process for plain aniline blacks, likewise chromed, well washed, and soaped three times to clear the whites, mangled and finished.

—J. H.

An Improved Method of and Apparatus for Dyeing.
S. Smithson, Bradford. Eng. Pat. 12,159, Oct. 13,
1885. 8d.

THIS invention relates to a method of extracting the colouring matter from dyewoods in such a way that the article to be dyed does not come in contact with the dyewood. The apparatus is shown in Fig. 1 (sectional elevation), and Fig. 2 (plan). The material to be dyed is placed in the vessel A, which also contains water. The water

as it rises above the level of the pipes M or L, returns to the dicing vessel A. The action thus becomes continuous.—E. J. B.

Improvements in Apparatus for Bleaching Light and Heavy Textile Fabrics and other Materials, by the "Thompson" and other Analogous Processes, which are also applicable for Dyeing Purposes. R. H. Ainsworth and E. B. Manby, London. Eng. Pat. 2051, Feb. 12, 1886. 11d.

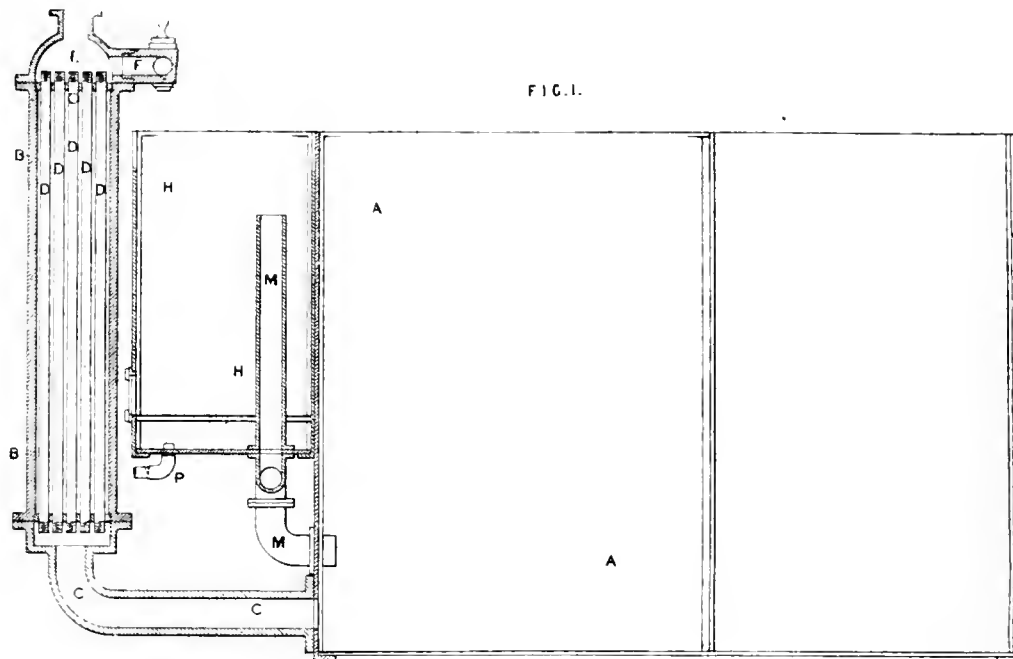


FIG. 1.

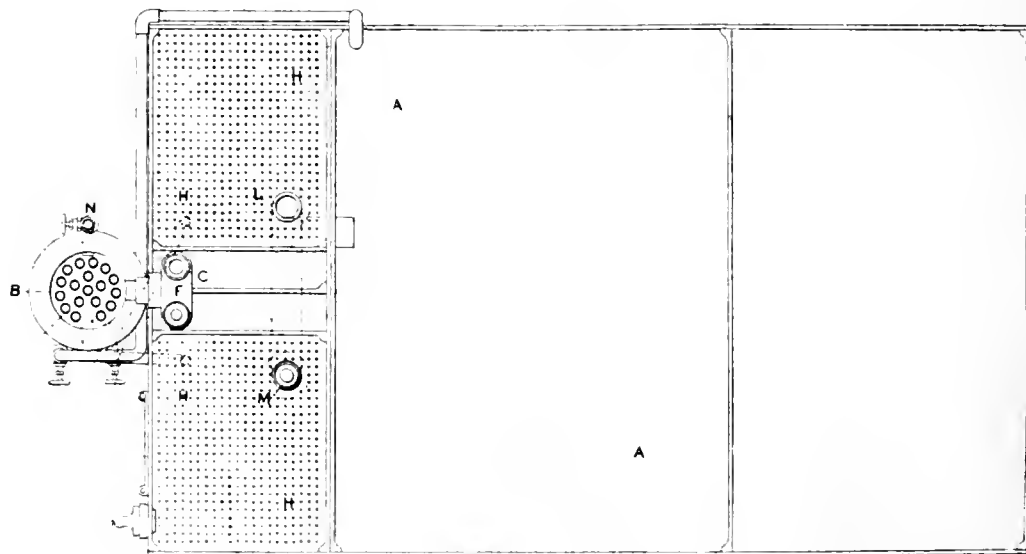


FIG. 2

from A passes by the pipe C and rises in the tubes D in the cylinder B. Steam enters by the cock N (Fig. 2), surrounds the pipes D, and heats the water contained in them, which, rising above the level of the water in A, overflows into the dome E (Fig. 1) and passes by the pipe F into the vessel H, which contains the dyewood. The hot water extracts the colouring matter, and as soon

THIS apparatus is an improvement on the apparatus patented by Thompson, Eng. Pat. 595, Feb. 3, 1883, and Mather, Eng. Pat. 16,663, Dec. 19, 1884. It consists essentially of a "dash wheel," shown in sectional elevation, Fig. 1, and plan, Fig. 2. The wheel is charged with the material to be bleached by means of the doors E, which are provided with simple

means of being hermetically closed. Bleaching liquor is run in by means of the stationary pipe A, is set in motion by the bevel wheel D, so as to thoroughly saturate the material. The wheel is then stopped, and

FIG. 1.

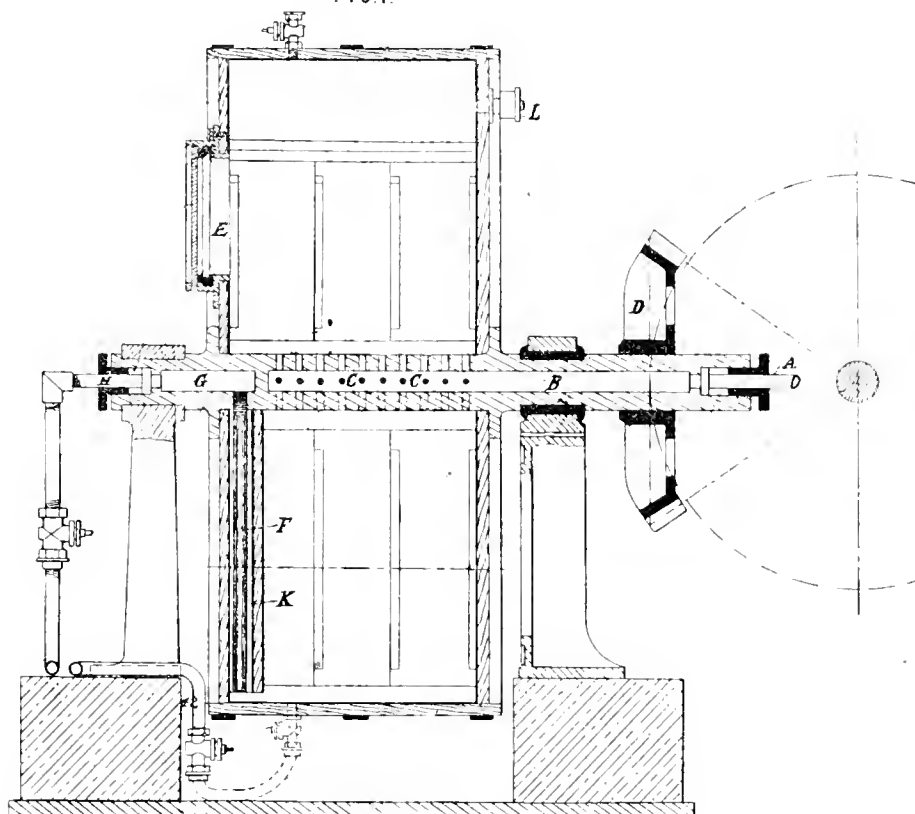
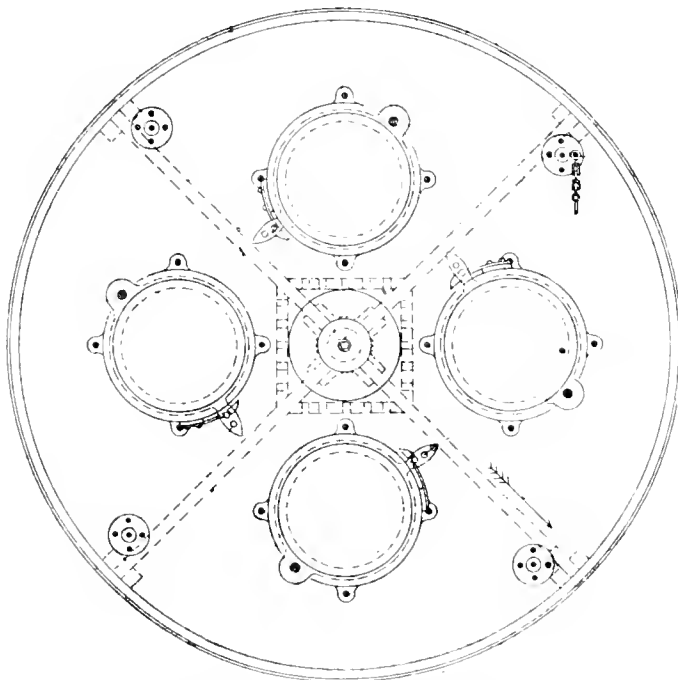


FIG. 2.



fitted by means of a gland into the hollow spindle B, the excess of liquor allowed to accumulate at the bottom, passing into the wheel by the perforations C. The wheel from whence it is pumped through the pipe F, chamber G,

and pipe H. The pipe F is enclosed in the casing K, to protect it from the action of the bleach. The wheel is then filled with carbonic acid gas by the pipe A. The material can also be washed and scoured in the same apparatus. The wheel is provided with a back pressure valve L, and also with suitable arrangements, such as friction clutch, etc., for starting and stopping.—E. J. B.

Improvements in Printing on Calico and other similar Woven Fabrics. A. S. Young, Wm. Rumney & Co., Ramsbottom. Eng. Pat. 14,975, Dec. 7, 1885. 8d.

THE object of this invention is principally to print the same pattern upon both sides of a fabric at one time, and upon exactly the same spot, by means of the ordinary cylinder printing machine without the use of the additional cylinder printing machine and other apparatus usually employed for this purpose.

Two copper rollers are engraved, exactly alike, one for the face and one for the back. In the first instance a "bump" or grey cloth is printed, then the white cloth is entered past the rollers that have printed on the "bump" in front of a plain copper roller, which gives it a "nip" and takes an impression or transfer on to the back of the white cloth, which then passes on to be printed on the face side by the other rollers in the ordinary way. To print four colours one copper engraved roller and three surface rollers are taken; these print the transfer or back, while the face side is printed with four engraved copper rollers in the ordinary way, fitting the pattern exactly on top of the transfer, which, when finished, is equal in appearance to cloth printed on a double-cylinder printing machine. The essential novel feature of the invention is the transferring of the printed pattern from the grey or other material to the back of the cloth, then printing on the face on the top of the transfer, the same being performed by a single operation in a single-cylinder or common printing machine.

By another modification of this process the "bump" may be dispensed with, and at the same time a second piece of calico or other material may be printed. This is done by passing a piece of printing calico between the "bump" and the first printing roller, so that this piece of calico receives the first pattern instead of the "bump," and transfers it to the back of the cloth as in the first instance. This additional piece of calico transfers only a portion of the colour forming the pattern to the back of the other piece and retains the rest. By this means two pieces of calico are printed at once, one on both sides, and the other on one side only. In cases where the additional piece of calico or other fabric is of sufficient thickness it may be substituted for the "bump" entirely, and thus the latter may be dispensed with.—J. H.

An Apparatus for Oxidising Aniline Black on Woven Fabrics. T. R. Shillito, London. From the Zittauer Maschinenfabrik und Eisengiesserei of Zittau, Germany. Eng. Pat. 7083, May 26, 1886. 8d.

THIS invention has reference to an apparatus for oxidising aniline black on all kinds of woven fabrics. It is composed of several separate compartments, perfectly shut off from each other, except at narrow apertures provided for the passage of the fabric, which latter, however, nearly or quite closes up each compartment. Oxygen, air and steam are blown into these compartments during the passage of the fabric through the same, the fabric being carried over reels or drums driven by machinery fixed outside the apparatus. Air is supplied separately to each of the several compartments through adjustable apertures, parallel to the travel of the fabric, which is in this way operated upon equably, and the edges of the same protected. The temperature and degree of moisture of the entering air is separately regulated for each compartment. Each compartment is provided with an exhauster, which exhausts the vapours arising from the evaporation of the mordants and other matters. One or more of the several compartments, preferably the last, is supplied with air more highly heated, and more impregnated with steam than the other compartments, or is supplied with steam alone.—J. H.

Improvements in Bleaching Compounds. Charles Toppin, Salem, Massachusetts, U.S.A. Eng. Pat. 7663, June 8, 1886. 4d.

THE improved bleaching compound consists of a mixture of oil of mustard seed, solid paraffin, caustic soda, tallow, soap, and sulphate of soda.—E. J. B.

VII.—ACIDS, ALKALIS, AND SALTS.

Improvements in the Manufacture or Production of Sulphur and Sulphuric Acid. E. W. Parnell and J. Simpson, Liverpool. Eng. Pat. 14,364, October 24, 1885. 6d.

THEORETICALLY the action of sulphurous acid on sulphuretted hydrogen is thus: $\text{SO}_2 + 2\text{H}_2\text{S} = 2\text{H}_2\text{O} + 3\text{S}$. In practice, the theoretical quantity of sulphur is never obtained, the loss being generally attributed to the formation of pentathionic acid. It is now proposed to cause the reaction, mentioned above, to take place in the presence of sulphuric acid, of 15° to 20° Tw., whereby the greater part of the sulphur contained in the two gases is precipitated in the vitriol and may be separated by subsidence, while thionic acids accumulate in the vitriol. The latter is boiled from time to time till it is of a sufficient density, say 15° to 20° Tw., when the thionates will be decomposed with formation of sulphur, sulphuric acid, and sulphur dioxide, which latter may be employed to decompose fresh sulphuretted hydrogen. The vitriol can be used repeatedly. As a suitable apparatus, a leaden tower, filled with flints, is recommended, down which the vitriol is caused to flow, while the sulphurous acid and sulphuretted hydrogen are admitted near the bottom, and caused to ascend in the contrary direction to the vitriol.—S. H.

An Improved Process for Separating Substances from Phosphate of Lime. T. R. Shillito. From E. Haensch and M. Schroeder, Oberhausen, Germany. Eng. Pat. 15,664, Dec. 19, 1885. 11d.

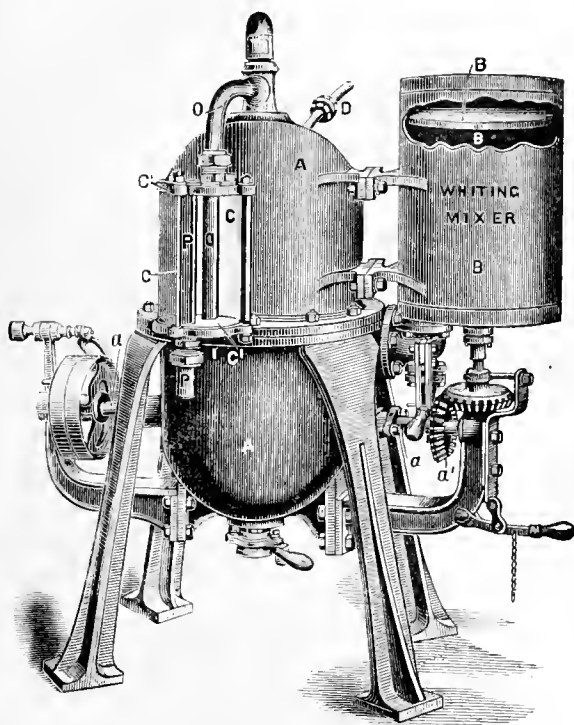
THE process involved in this invention is based on the property of sulphurous acid of dissolving basic calcium phosphate in the cold state, when acid calcium phosphate and calcium bisulphite are produced. At boiling heat the phosphoric acid expels the sulphurous acid from the compound formed, the acid calcium phosphate being thereby reconverted into basic phosphate. By this means calcium phosphate may be separated from all those substances which are insoluble in sulphurous acid. But if calcium phosphate is accompanied by caustic lime, calcium carbonate, or similar compounds, as is the case in Thomas-slag, a special preliminary treatment is required. For this purpose the lime is converted into gypsum by adding to the pulverised material the quantity of sulphuric acid necessary for neutralising the excess of lime, an intimate mixture being obtained by stirring. The resulting mass is formed into blocks and heated to red heat, giving a porous material, which is broken into pieces, placed in vats, arranged on the contrary current principle, and supplied with a strong aqueous solution of sulphurous acid. The solution obtained is heated in lead pans to from 60° to 70° C., when basic calcium phosphate is precipitated, whilst sulphurous acid is evolved, which is absorbed in water or a weak solution of acid calcium phosphate. For the carrying out of the process, and a description of the apparatus required, the original specification should be consulted.—S. H.

Improvements in Lids applicable to Caustic Soda, Drum Heads, and to other purposes. G. H. Bolton and J. Leathwood, Widnes. Eng. Pat. 14,279, Nov. 21, 1885. 6d.

AN invention by means of which the lids of caustic soda drums can be most tightly screwed down, without however forcing the lid off, a collaterally induced compensating action preventing this.—S. H.

Improvements in Apparatus for Generating Carbonic Acid Gas. J. Chapman and R. Foote, Liverpool. Eng. Pat. 13,099, Oct. 30, 1885. 8d.

A is a gas generator of cast-iron, lined with lead. B is a store-vessel for whiting, or its equivalent. Both vessels are fitted with mechanical agitators, driven by the shaft *a*, and bevel wheels *a'* and K. The vessel B is connected with A by a passage through which a supply of whiting



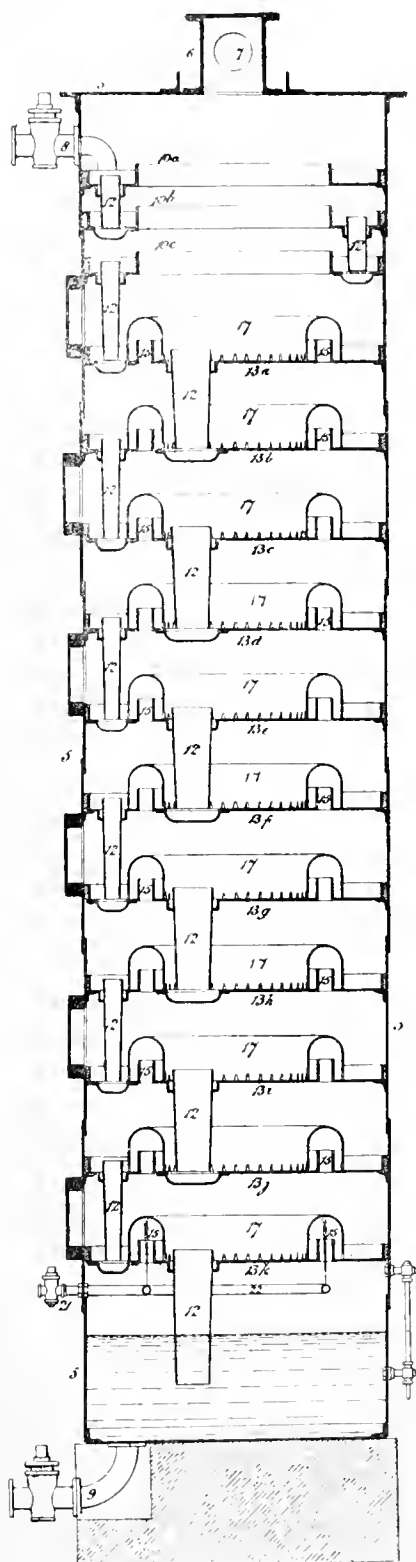
can be shot into the gas generator. The purifier C is made of glass, and connected by a pipe O with the top of the generator. The gas-escape pipe P enters through the bottom of the purifier, and passes upwards above the level of the water used for purifying the gas. D is a pipe for the supply of acid.—S. H.

Improvements in Apparatus for Distilling Ammonia. N. M. Henderson, Broxburn, N.B. Eng. Pat. 15,836, Dec. 24, 1885. 8d.

A VERTICAL CYLINDRICAL STILL is provided at the top with a pipe 8 (Fig. 1) for the admission of the ammoniacal liquor. The latter then passes into an annular open-topped channel 10^a, after travelling round which it descends successively into a second and a third similar channel 10^b and 10^c, and lastly upon the uppermost of a series of horizontal diaphragms 13^a and 13^k. Each diaphragm consists of an outer annular part 13 (Fig. 2), and a movable middle disk-shaped part 14, forming an annular opening 15 between them. The movable middle part rests on projections, so that it can be lifted out for cleaning purposes. A raised wall is formed round each edge of the opening 15, which is covered by an inverted channel-shaped piece 17, the sides of which are notched from the bottom to within half-an-inch of the working level of the liquid, and the steam or vapour passing up through each annular opening 15 finds its way through the notches amongst the liquid lying upon the diaphragm. At suitable points an overflow pipe 12 is fixed in each diaphragm and dips down into the liquid on the next one. The annular opening 15, with its cover 17, does not extend to a complete circle, a passage 19 (Figs. 2 and 3) being formed across it at one part, and a low partition

20 is placed so as to extend from the side of the still through the passage 19 across the disk of the diaphragm.

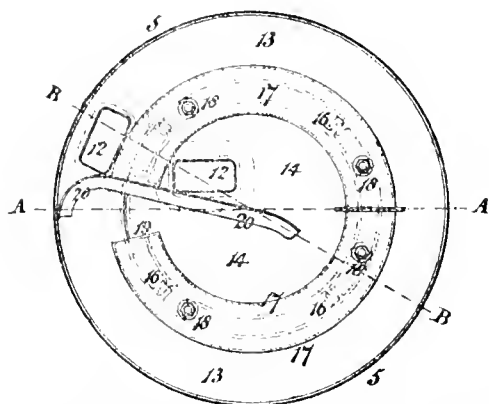
FIG. 1.



Owing to this partition the liquid descending from an upper diaphragm is made to pass first round the outside

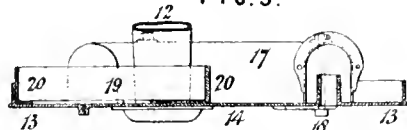
of 15, and then round the inside on one diaphragm, next round the inside and lastly round the outside of the next lower diaphragm, and so on alternately, the overflow pipes 12 being alternately on the outer and inner sides of 15. The steam for heating the ammoniacal

FIG. 2.



liquor enters below the lowest diaphragm 13^k, the gases given off escape at the dome 7, whilst the exhausted liquid leaves at 9. It is claimed that the distilling and volatilising action of this apparatus is very effective and expeditious, owing to the liquid on the diaphragms

FIG. 3.



moving in currents round the outer and inner sides of the openings 15. The currents also prevent deposits on the diaphragms, so that the apparatus requires cleaning less frequently, the construction at the same time facilitating cleaning operations.—S. H.

An Improvement in the Production of Sulphuric Acid. H. J. P. Sprengel, London. Eng. Pat. 10,798, August 24, 1886. 8d.

THE patentee proposes to use the exhaust steam from steam-engines in the leaden chambers employed for the

other, the same work may be done by the same engine, if the pressure be kept at 40lb. per square inch on the one side of its piston and at 10lb. on the other. As, however, a pressure of 10lb. per square inch is ample for the steam entering the chambers, it is suggested, (1) to raise the pressure in the steam-boiler by 10lb. per square inch; (2) to drive the engine at this higher pressure; (3) to make the exhaust steam from the engine enter the chambers at a pressure of 10lb. per square inch; and (4) to supplement, when needed, any deficiency of steam in the chambers by steam of the same pressure from the same boiler. The annexed drawing, which will be readily understood without further explanation, shows a convenient arrangement.

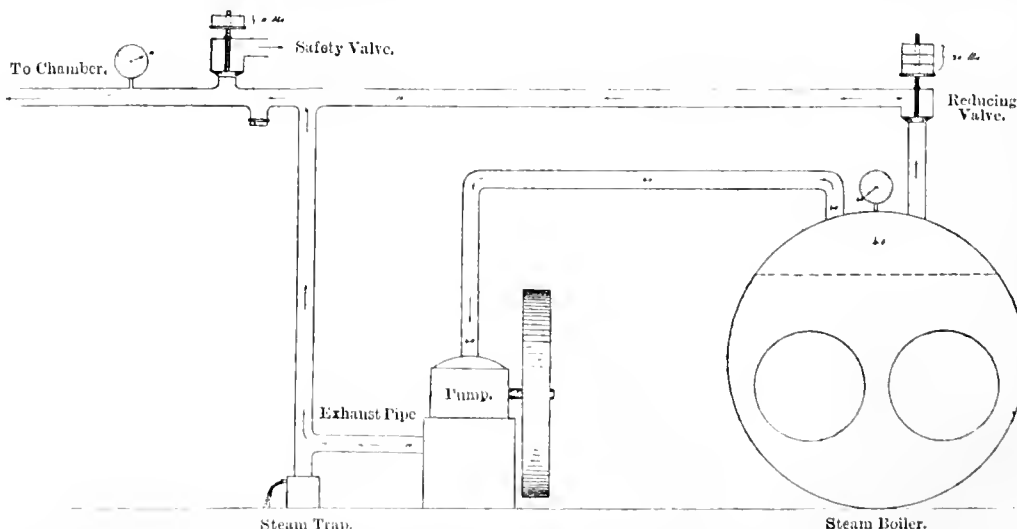
—S. H.

Improvements in the Production of Pure Carbonic Acid Gas. E. W. Parnell and J. Simpson, Liverpool. Eng. Pat. 46, Jan. 2, 1886. 8d.

DILUTE or impure carbonic acid gas obtained from a lime-kiln or from any other source, is, after washing and cooling, brought into contact with a cold aqueous solution containing from 25 to 30 per cent. ammonium carbonate, taking care that the temperature never exceeds 70° F. Crystals of ammonium bicarbonate are formed, which are separated from the mother-liquor and heated to 165° F. in a closed vessel. Carbonic acid is evolved, carrying with it some ammonium carbonate and aqueous vapour. The gas, after passing through a cooling apparatus, which returns all the products of condensation to the heating vessel, is washed with acid, water, or brine to deprive it of any trace of ammonia, and is then ready for use. The liquor which remains in the heating vessel is cooled, when it deposits another crop of ammonium bicarbonate crystals, which are separated and heated as previously described, whereas the mother-liquor returns to the absorbing apparatus for carbonic acid.—S. H.

Improvements in the Manufacture of Carbonate of Soda with Production of Sulphuretted Hydrogen. E. W. Parnell and J. Simpson, Liverpool. Eng. Pat. 47, Jan. 2, 1886. 6d.

THE ammonium chloride produced in the ammonia soda process is decomposed by means of Leblanc waste, and the ammonium sulphide vapour given off is absorbed in water or in a weak ammoniacal solution until it contains from 8 to 10 per cent. of ammonia. This strong solution, after cooling, is subjected to the action of a current of carbonic acid gas until crystals of ammonium bicarbonate are formed and sulphuretted



manufacture of sulphuric acid in the following manner. Supposing the engine works with steam of 30lb. pressure per square inch on the one side of the piston and nil on the

hydrogen is evolved. The latter, after being washed to arrest any carbonic acid and ammonia, is conducted to a gas-holder for use. The ammonium bicarbonate

crystals, along with a portion of the mother-liquor, is removed from the carbonating apparatus, and after draining agitated in a solution of sodium chloride, when sodium bicarbonate is formed, which is converted into monocarbonate. The ammonium chloride remaining in the mother-liquor enters again the cycle of operations by being heated with vat-waste, and so forth. The ammonia which is removed in the form of bicarbonate and mother-liquor from the carbonating apparatus, is compensated for by the addition of ammonium sulphide, so that the strength of the ammoniacal liquor in the apparatus is maintained at the same degree. The mother-liquor from the carbonating apparatus is used for absorbing the ammonium sulphide given off in the first stage of the process. As the purity of the sulphuretted hydrogen evolved depends upon the purity of the carbonic acid gas employed, it is desirable to use the latter as pure as possible (see Eng. Pat. 46, 1886).—S. H.

Improvements in the Manufacture of Phosphoric Acid.

W. B. Giles and A. Shearer, London. Eng. Pat. 715, Jan. 16, 1886. 6d.

THE inventors have discovered that at an elevated temperature phosphoric acid distils freely in presence of a current of steam or hydrochloric acid. They make use of this property to obtain pure phosphoric acid from an impure acid, prepared in the usual manner from calcium phosphate and sulphuric acid and concentrated to a syrupy condition.—S. H.

VIII.—GLASS, POTTERY, AND EARTHENWARE

The Etching of Glass by means of Hydrofluoric Acid.

F. Reinitzer. Dingl. Polyt. J. 262, 322–329.

WOEHLER states, in his well-known translation of Berzelius' work on chemistry, that a dilute solution of hydrofluoric acid produces a transparent etching on glass, whereas the concentrated or gaseous hydrofluoric acid gives an opaque appearance to glass. The author's experiments do not correspond with the second part of this assertion. For the preparation of opaque etchings on glass, three processes are in use—viz., (1) the application of solutions of acid fluorides of the alkalis, (2) a mixture of fluorspar with sulphuric acid, or (3) hydrofluoric gas. As regards the first process, the solutions of the acid fluorides always contain more or less of uncombined hydrofluoric acid, as well as an indifferent salt, as shown in the following recipes of solutions:—

	I.	II.	III.
	Grms.		
Water	1000	100	1000
Acid Potassium Fluoride..	250	—	—
Sodium Fluoride	—	—	40
Ammonium Fluoride	—	—	—
Alkali Fluoride	—	8	—
Hydrochloric Acid	250	—	160 to 175
Sulphuric Acid	—	1	—
Glacial Acetic Acid	—	—	50
Potassium Sulphate	140	—	200
Ammonium Sulphate.....	—	—	—

The first recipe is recommended by Tessié du Mothay and Maréchal, the two under II. by Siegwart, the two under III. by J. B. Miller. In practice an acetic solution of sodium fluoride is much used, which is made by dissolving twenty-five parts of sodium carbonate crystals in five parts of fuming hydrofluoric acid, and adding to one litre of this solution, after clarifying, one litre of glacial acetic acid.

It is often necessary to etch glass in different shades of opacity; for instance, in etching landscapes on glass. For light shades a single application of hydrofluoric acid is sufficient, whereas a dark shade requires the repeated etching of the same spot. If an etched glass-plate be examined under the microscope, a uniform distribution of elevations and depressions is observed which have the shape of crystals. These become scarier near the edge, but their shape is more perfect there. Fig. 1 represents the edge of an etched plate. The crystals are hexagonal and agree with those of silicon-sodium-fluoride. There are also a few of a longish shape, which

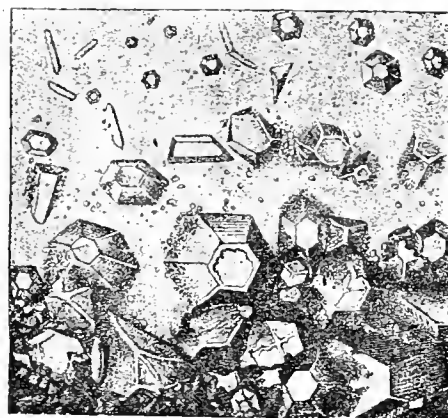


FIG. 1.—Scale 450 : 1.

are very like those of silicon-calcium-fluoride. The crystals standing in relief on the glass plate, it is believed that alkali fluoride and hydrofluoric acid act on the glass, forming silicon-sodium-fluoride and silicon-calcium-fluoride, which are set free in a crystalline form, whereas hydrofluoric acid etches the spaces between the crystals. Silicon and calcium are derived from the glass, sodium partly from the etching-bath and partly from the glass. On etching potash glass, tesseral crystals of silicon-potassium-fluoride can be observed, and this suggests a simple method for the detection of potash glass. In connection with these

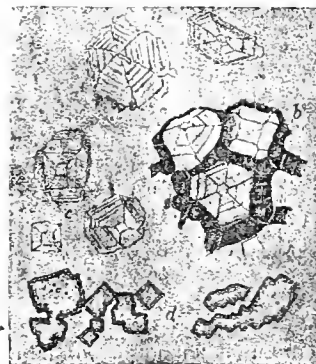


FIG. 2.—Scale 250 : 1.

observations, we can also determine the composition of any etching-bath according to the end which is desired. It is obvious that the etching will be the finer and the more delicate the smaller the crystals are, and *vice versa*. Small crystals are formed from concentrated solutions, consequently a concentrated bath gives a delicate etching. But, on the other hand, it is not immaterial whether a potassium, sodium, or ammonium fluoride be used. The first being the least soluble, produces the finest opacity. From the same cause ammonium compounds must be applied very concentrated, sodium compounds less, and potassium compounds still

less concentrated. The action of a bath being quicker, if the solution be concentrated, it follows that ammonium compounds will act quickest. The addition of indifferent salts and free hydrofluoric acid is, indeed, for the following purpose—viz., to modify the solubility of silicon fluorides and the rapidity of the crystallisation; the presence of indifferent salts diminishing the solvent power, the presence of free acid increasing the solvent power of fluorides. In using potassium or ammonium compounds, the etchings have a different appearance from those produced by sodium compounds. If a soda glass be etched with a potassium compound, the crystals

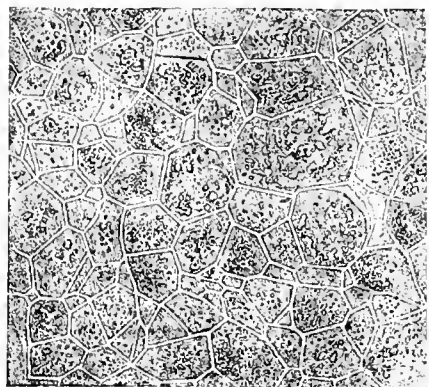


FIG. 3.—Scale 300 : 1.

of silicon-potassium-fluoride, silicon-sodium-fluoride, and silicon-calcium-fluoride can be observed under the microscope, either in the shape of a hexahedron or an octahedron, or a combination of either (Fig. 2). On etching a glass-plate with dilute hydrofluoric acid, crystals are formed in the first instance, but on a prolonged and repeated action of the acid, their shape widens, until it completely disappears, producing the appearance as shown in Fig. 3. Here the polygons are deepened, making the lines stand out in relief. The so-called etching inks by which opaque writing is produced on glass, belong to the same class of etching fluids, as they

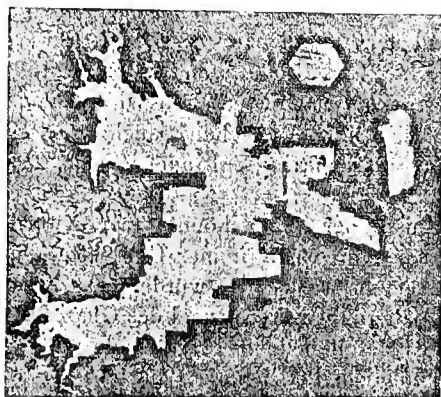


FIG. 4.—Scale 300 : 1.

consist of alkali fluorides with an addition of gum or barium sulphate as a thickening. As to the proportion of the different constituents in an etching bath, definite statements can only be made with regard to a glass of a specific composition. Supposing the formula of glass to be $R_2Si_2O_7$, R being a monatomic metal—the reaction which represents the process of etching is represented by the following equation: $R_2Si_2O_7 + 4NaHF_2 + 10H_2F = SiF_6R_2 + 2SiF_6Na_2 + 7H_2O$. There must be present a large amount of free hydrofluoric acid in order to utilise all the sodium fluoride. This large amount of free hydrofluoric acid proves, however, injurious, and it is therefore preferable to bring about the neutralisation of

the bases by the addition of acetic acid, which does not decompose the acid alkali fluorides. The process is, then, thus: $R_2Si_2O_7 + 9NaHF_2 + 5C_2H_3O_2 = SiF_6R_2 + 2SiF_6Na_2 + 5C_2H_3Na + 7H_2O$. The proportion of sodium fluoride to acetic acid is 93 to 50, or 9 to 5 approximately. If the acid fluoride is replaced by neutral sodium fluoride, the proportion is 9 to 10, which nearly corresponds with Siegwart's recipe (8 to 10) previously mentioned. The application of gaseous hydrofluoric acid does not produce a uniform opacity, and is, therefore, not suitable for the production of opaque plates. A

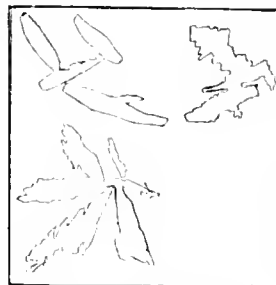


FIG. 5.—Scale 200 : 1.

plate treated with gaseous hydrofluoric acid and examined under the microscope is represented in Figs. 4 and 5. There is an agglomeration of different crystals and a large number of small recesses. This is owing to the fact that in the beginning of the process numerous small drops of water condense on the glass, dissolving hydrofluoric acid and restricting the etching process locally. A good opaque etching can be produced by fluorspar and dilute sulphuric acid (1 : 4) at a temperature of 30° to 40° C. Fig. 6 shows a plate etched in this manner. The surface is covered with many minute depressions of different depth, between which there are elevations of no

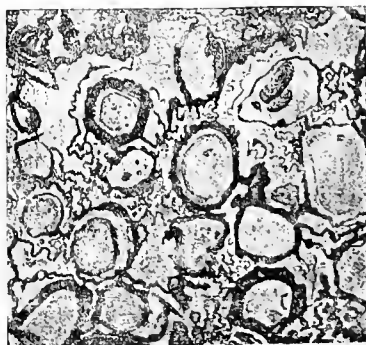


FIG. 6.—Scale 450 : 1.

definite shape. These are due to an incomplete etching, caused by a piece of fluorspar covering that spot and thus protecting it from the action of the hydrofluoric acid. Near the edge the sulphuric acid can act on the fluorspar, forming hydrofluoric acid, which etches a groove round the protected spot. In conclusion, the author points out that chemical etchings are easily distinguished by the microscope from mechanical etchings produced by the sand-blast or grinding. The latter methods cause numerous fractures of various direction and size, all of which exhibit a characteristic 'conchoidal' appearance.—S. H.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Preservation of Timber by Means of Aluminium Chloride.
F. Filsinger. Chem. Zeit. 10, 1270—1271.

THE author has made a series of experiments on the preservation of oak and firwood after saturation with solu-

tions of aluminium chloride. The prepared specimens of timber were placed in damp garden mould rich in humus, and after about eighteen months' rest were removed and examined. The wood was found to be in good condition, whilst specimens of untreated wood, which had also been placed in the putrefying pit, were all rotten. It is not necessary to employ pure aluminium chloride, as it was found that the wood prepared with the crude salt containing iron was in most cases better preserved; the presence of free hydrochloric acid is, however, objectionable, owing to its destructive action on the woody fibre.

It is doubtful whether the present price of aluminium chloride would admit of its application to the preservation of railway sleepers; it is thought, however, that for other purposes where it is essential to use preserved timber, the use of this salt would compete favourably with other preserving agents.—D. B.

A New or Improved Combination of Materials for Making Cements, capable also of being used for other Useful and Ornamental Purposes. T. Smith, Sunbury. Eng. Pat. 13,328, Nov. 4, 1885. 6d.

THE debris of macadamised roads, broken china or porcelain, are washed, calcined and ground to a fine powder; 60 parts of the resulting powder are mixed with 40 parts of sulphur, and melted in a copper pan provided with an agitator. The heating is continued up to 250° C., after which the source of heat is withdrawn, and the stirring continued until the mass assumes a thin condition. It is then poured on to a slab or flat surface, and allowed to cool in a thin layer. It is again melted and cast into slabs, which are ready for use for a variety of purposes.—C. C. H.

Improvements in the Treatment and Utilisation of a certain kind of Clay. F. Candy, London. Eng. Pat. 15,948, Dec. 28, 1885. 6d.

THE carbonaceous clay found in Devon is ground, preferably wet, and incorporated with about 10 per cent. of chalk or limestone in a pug mill. It is then carbonised (ignited or roasted); or it may be first dried and afterwards carbonised. The product as thus prepared is reduced to a small state of division, dependent upon the purpose for which it is intended—*e.g.*, decolourising liquids in the purification of water or sewage. Carbonised after treatment as above described, without the addition of carbonate of lime, it may be ground with oil or silicate of soda, and used as a paint, or pressed into blocks or slabs suitable for carbon electrodes or for crayons and pencils.—C. C. H.

An Improved Material applicable as a Waterproof Covering for Roofs and other such like Purposes. A. Ford and J. A. Archer, London. Eng. Pat. 5993, May 15, 1885. Amended Oct. 11, 1886. 6d.

IRON WIRE GAUZE is successively dipped in linseed oil having the property of drying, and dried until the meshes are wholly closed and the wire covered. The result is a transparent, waterproof sheet, adaptable as a roof covering. Boiled oil should not be used; that found most suitable is prepared by first adding litharge to the oil and then subjecting to a blast of air in a closed tank.—C. C. H.

X.—METALLURGY, Etc.

Antimony Production in Banya. C. A. M. Balling. Chem. Zeit. 10, 1198–1199.

THE author having recently visited the new antimony works at Banya, now gives data as to the capabilities of the mines and works, and analytical details of the products and by-products. Lump ore is obtained in small proportions, and consists partly of antimonite, and partly of oxides. By far the largest amount of ore worked up here is that occurring in graphitic schist. At the present rate of working the annual production amounts to 200,000 kilos. of regulus, and 140,000 kilos. of crude antimony;

and experiments are now being made in connection with the manufacture of antimony red, and also of antimonious oxide. The lump and jigged ore are liquated in four reverberatory furnaces, each of which has 50 pots, holding 11 to 12 kilos. of charge. The ore subjected to this process has an average composition of Sb=50; Fe=12; SiO₂=9; CaCO₃=2; S=26 per cent. The crude antimony contains Sb=69.5; As=0.6; Fe=1.2; S=27.2; insoluble 0.7 per cent. The liquation residues also contain 21 to 25 per cent. of antimony, and these, together with flue-dust, collected at different stages, refinery slag, and the more impure crude metal, serve as material for the smelting process in the blast furnaces. These residues are first roasted on a bed of wood in kilns for six to seven weeks, and then subjected to the smelting process in the blast furnace with an admixture of 20 per cent. of fuel. The fuel as to proportion, usually consists of one-fourth by weight of coke in small porous lumps, and the remainder of wood charcoal. An analysis of the roasted residues gave the following figures:—Sb=32.06; Fe₂O₃=17.36; SiO₂=49.20; Al₂O₃=2.35; CaO=0.72; S=2.43 per cent. An analysis of the blast furnace slag gave—

	Before tapping.	After tapping.
SiO ₂	50.30	49.20
CaO	25.90	27.66
FeO)	20.25	19.17
Al ₂ O ₃)		
Sb	2.07	0.90

It may here be noted that the presence of 20 per cent. of iron in the slag is indicated by experience as being necessary for the most advantageous working of the blast furnace process. For the preparation of antimonious oxide only such ores as contain 40 per cent. and upwards of antimony are employed in these works.—W. D. B.

XI.—FATS, OILS, AND SOAP MANUFACTURE.

Treatment of Mineral Oils with Arsenical Sulphuric Acid. Dr. Krey. Chem. Zeit. 10, 1272.

THE author is of opinion that sulphuric acid, containing arsenic, may be used without disadvantage for the purification of mineral oils, it being impossible to detect even traces of this substance in oils thus treated.—D. B.

Improvements in the Separation and Treatment of Fatty Matter from Compounds containing Wool Fat. C. D. Abel, London. From the Fabrik Chemischer Produkte Actien Gesellschaft, Berlin, Germany. Eng. Pat. 14,957, Dec. 5, 1885. 6d.

IN Glaser's patent (Eng. Pat. 4992 of 1882) are described processes for the production of "lanolin," the combination of neutral fatty matter from wool with water, which are subsequently separated by centrifugal action. The present patentee effects the separation mainly by largely diluting the liquid, or by adding to the solution soluble salts of the alkaline earths or of the heavy metals, or, in some cases, by simple subsidence, or by all three processes combined.—W. L. C.

Improvements in the Manufacture of Soap. R. Park and J. E. Park, Glasgow. Eng. Pat. 1113, Jan. 25, 1886. 6d.

KIESELGUHR, diatomite, or white peat powder, is incorporated with the soap paste before the latter solidifies. When a large percentage of kieselguhr is used, pipe-clay is added as well to prevent the mixture from being too friable.—W. L. C.

Improved Apparatus and Method of Treating Cotton Waste which has been used by Lithographic and Letterpress Printers, and obtaining Products therefrom. C. O'Neill, Manchester. Eng. Pat. 6762, May 20, 1886. 8d.

A VERTICAL BOILER of thin plate is filled with the waste, steam is blown in, and the mixed vapours of water and

turpentine are condensed in a worm, after which the two liquids are separated by the differences in their specific gravity.—W. L. C.

A Method and Apparatus for Extracting the Fat from Bones. T. Berliner, Ohlan, Silesia, Germany. Eng. Pat. 11,138, Sept. 1, 1886. 8d.

THIS patent contains the drawing of, and description for working, an apparatus in which superheated "benzine" vapour is made to act upon the bones in order both to dry them and to extract their fat simultaneously. The vapour employed is that arising from the evaporation of the solution produced in a previous operation, and the superheater is an iron vessel fed with superheated steam or air. The benzoline (petroleum spirit) vapour may be introduced either above or below the material to be extracted.—W. L. C.

XII.—PAINTS, VARNISHES, AND RESINS.

Lanolin. C. D. Abel. Eng. Pat. 14,957, Dec. 5, 1885. 6d.

THIS patent relates to some modifications upon the process described in a previous patent (Eng. Pat. 4992, 1882), for the preparation of "lanolin." Instead of separating the crude wool-fat by centrifugal action, the fat may be allowed to rise to the surface of the soapy liquid, and then be separated; the same result is effected by making a jet of water play upon the liquid, also by two other methods, involving the separation of the fat into fatty acids; and the applicant also claims for the use of other substances than the alkalis specified in the first patent. Notably he claims for the use of bicarbonates, silicates, borates, and all vegetable substances containing saponine, and for substances containing pancreatine, ether, or all of which, might be used for producing an emulsion of wool-fat.

XIII.—TANNING, LEATHER, GLUE, AND SIZE.

Improvements in Making Size or Dressing Material for Textile Materials and Fabrics, and to be used in Polishing Twine, String, or Cord. A. Hieronimus, Strassburg, Alsace. Eng. Pat. 15,953, Dec. 29, 1885. 6d.

THE improved size is made by boiling meal, which has been used with eggs for tawing skins, with four times its weight of water. An equal weight of scraps of kid or other skin is boiled in about six times its weight of water and the filtered solution thoroughly mixed with the meal paste. A little suitable antiseptic may be added.—B. H.

An Improved System of Tanning Hides and Skins by Continuous Application of Liquors, and New Mode of Suspending and Lifting Hides and Skins in "Shifting Frames" while in Process of Tanning. T. Brain, London. Eng. Pat. 7274, May 31, 1886. 11d.

THIS consists of a "round" of any suitable number of pits connected together so that liquor introduced into the first pit traverses the series. The fresh liquor flows from a raised cistern through a pipe ending in a circular chamber at the centre of the bottom of the pit, and issues into the pit through equidistant apertures round the sides of the chamber. A pipe connects the top of this pit with a similar arrangement in the next pit, and so on through the series. The hides are hung on swivel hooks attached to laths fixed in a frame. This frame rests on a groove round the top of the pit, and can be raised by suitable machinery with the hides and shifted from one pit to another. Perforated rods are suspended between the hides to keep them apart and allow free access of liquor. The rate of flow of the liquor through the series of pits can be regulated as found necessary.

—B. H.

XIV.—AGRICULTURE, MANURES, Etc.

Further Disintegration of Thomas-Phosphate Slag under the Influence of the Atmosphere. E. Jensch. Chem. Zeit. 10, 1271.

SINCE Wagner (Darmstadt) has shown that the solubility of the phosphoric acid in basic cinder from the Thomas process increases with the fineness of the slag, it has been stipulated by agriculturists to reduce the cinder by grinding to the finest possible condition. As this operation necessarily increases the price of the cinder the author made a series of experiments, the object being to save this extra expenditure. He found that coarsely-ground slag disintegrates still further under the influence of the atmosphere, so that by exposing it to the air for a few weeks the additional grinding operation may be abandoned.—D. B.

Use of Phosphoric Acid as Addition to Manure Liquors instead of Sulphuric Acid. K. H. Neuller. Chem. Zeit. 10, 1272.

FRESENIUS states that potassium phosphate is a highly active and valuable manure, a statement which is confirmed by H. and E. Albert, of Biebrich-on-the-Rhine, in a series of experiments with potassium phosphate extended to market gardens and vineyards. In a recent communication the author gave an account of some experiments made with ammonium phosphate, the results being very satisfactory. It is now shown that farmers can procure a considerable portion of the potassium and ammonium phosphate they need, by adding phosphoric acid to the manure liquors instead of sulphuric acid.—D. B.

Improvements in the Treatment of Phosphoretic Slag. A. Bobrownieki, London. Eng. Pat. 948, Jan. 21, 1886. 6d.

THE object of this invention is to reduce Thomas-slag to a state that will admit of its being used as a fertiliser. To this end, the powdered slag is moistened with water and treated with concentrated sulphuric acid, stirring the materials to produce an intimate mixture, while at the same time water is added for supplying the requisite water of combination and creating the heat necessary for the reaction. In place of sulphuric acid, soluble bisulphates may be used, neutral sulphates being thus formed, which are recovered by lixiviation.—S. H.

XV.—SUGAR, GUMS, STARCHES, Etc.

The Decomposition of Milk-sugar by Dilute Hydrochloric Acid. M. Conrad and M. Guthzeit. Ber. 19, 2575—2576.

MILK-SUGAR, when acted upon by dilute acid, has long been known to yield acetopropionic acid and formic acid. The authors have now determined the action quantitatively, in the same manner as in the preceding experiments (this Journal, vol. v. 36). Milk-sugar was heated with 9—10 per cent. hydrochloric acid for 17 hours with an inverted condenser in a salt bath. The results obtained are given in Table A on next page.

From former experiments on dextrose and galactose the authors obtained the following numbers:—

	Humin 8.1 auev.	Unchange- d.	Acetopropi- onic Acid.	Formic Acid.
Dextrose, 52.5grms.	1.76	14.32	15.53	6.51
Galactose, 52.5grms.	8.40	16.60	11.22	5.10
Milk-sugar, 105grms.	13.16	31.12	29.75	11.91

Whilst from the above results were calculated:—

Milk-sugar, 105grms.	18.03	27.70	31.20	12.13
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The numbers for humin substances and unchanged sugar do not agree very closely, but those for acetopropionic acid and formic acid agree as well as can be expected from the method employed, and show clearly

The methods used for the determinations were exactly the same as in the above-quoted paper. The results with dilute sulphuric acid are given in Table I. These numbers calculated for 52.6 grms. of dextrose

TABLE A.

SUBSTANCES TAKEN (IN GRAMMES).				DECOMPOSITION PRODUCTS (IN GRAMMES).			
	Milk-sugar with Water of Crystallisation.	Water.	Hydrochloric Acid.	Humin Substances.	Unchanged Sugar.	Acetopropionic Acid.	Formic Acid.
1	21	50	4.87	3.68	5.54	6.29	2.39
2	21	50	5.00	3.94	not deter.	5.80	2.24
3	10.5	50	4.87	1.60	..	3.32	1.33

in what manner dextrose and galactose are formed by the decomposition of milk-sugar. The following numbers show the behaviour of equivalent amounts of different carbohydrates with 9–10 per cent. hydrochloric acid when heated for 17 hours:—

	Humin Substances.	Unchanged Sugar.	Acetopropionic Acid.	Formic Acid.
100 Cane-sugar yield	18.9	20.6	33.2	13.8
100 Milk-sugar (anhydrous) ..	18.0	27.7	31.2	12.1
105 Dextrose	9.5	29.0	31.1	13.1
105 Levulose	21.3	—	39.6	17.6
105 Galactose	16.8	33.2	28.4	10.8
105 Arabinose	43.0	—	12.4	4.2

—G. H. M.

Action of Dilute Acids on Dextrose and Levulose. M. Conrad and M. Guthzeit. Ber. 19, 2569–2574.

TOLLENS and GROTE have shown that when sucrose is decomposed with dilute sulphuric or hydrochloric acid, the greater portion of the acetopropionic acid formed comes from the levulose, since dextrose when decomposed with these acids only yields very slight traces of aceto-

and levulose—i.e., the quantities corresponding to 100 grms. cane-sugar, gave the following:—

	Humin Substances.	Dextrose.	Acetopropionic Acid.	Formic Acid.
{ Dextrose, 52.6 grms.	0.83	43.70	12.78	1.21
{ Levulose, 52.6 grms.	13.78	—	16.78	6.46

= Cane-sugar, 100 grms. 11.61 43.70 19.56 7.67

These numbers agree very closely with those found in the former experiments with cane-sugar. The mean of five experiments was:—

	Humin Substances.	Dextrose.	Acetopropionic Acid.	Formic Acid.
Cane-sugar, 100 grms.	16.6	43.3	17.5	8.

It is thus seen that the greater part (94 per cent.) of the humin substances and acetopropionic acid (85 per cent.) formed by the decomposition of cane-sugar with dilute sulphuric acid proceeds from the levulose which completely disappears, whilst about 83 per cent. of the dextrose formed by the inversion remains untouched.

The action of dilute hydrochloric acid was examined in the same way. The results are given in Table II. on next page. These numbers calculated for 52.6 grms. of dextrose and levulose gave the following results,

TABLE I.

SUBSTANCES TAKEN (IN GRAMMES).				DECOMPOSITION PRODUCTS (IN GRAMMES).			
	Sugar.	Water.	Sulphuric Acid.	Humin Substances.	Unchanged Sugar.	Acetopropionic Acid.	Formic Acid.
Dextrose..... {	10.5	50	3.50	0.13	8.54	0.51	0.25
	10.5	25	1.75	0.20	8.87	0.56	0.23
Levulose..... {	10.5	25	1.81	2.60	trace	3.50	1.33
	10.5	20	1.71	2.90	..	3.20	1.25

propionic acid. They also found that there is a relationship between the formation of this acid and the separation of humin substances. The authors confirmed this in their experiments on cane sugar (Ber 18, 439), in which they found a large percentage of dextrose remained unacted upon. In order to again confirm this action, the authors acted upon quantities of dextrose and levulose corresponding to 20 grms. cane sugar for 17 hours with the same quantities of acid and water as before. Levulose could only be indirectly used, since it is most difficult to obtain pure. Inulin, which is completely converted into levulose by the action of dilute acids, was employed.

which agree closely with those formerly found for cane-sugar:—

	Humin Substances.	Unchanged Dextrose.	Acetopropionic Acid.	Formic Acid.
{ Dextrose, 52.6 grms.	4.76	11.52	15.53	6.51
{ Levulose, 52.6 grms.	10.65	—	16.28	8.73
= Cane-sugar, 100 grms.	15.11	11.52	31.81	15.29

Dextrose gives with 8–10 per cent. of hydrochloric acid nearly as much acetopropionic acid as levulose, whilst with 7–8 per cent. of sulphuric acid it is almost untouched. The proportion between acetopropionic and formic acids is nearly the same in all the decompositions—viz., 1:2.35. The amount of humin substances formed by acting upon 100grms. cane-sugar, with sulphuric and hydrochloric acids respectively, is almost the same, but with the former acid only 5.7 and with the latter acid 30.8 of the total amount is formed from dextrose. 10.5grms. of dextrose heated with 50cc. concentrated hydrochloric acid yielded 4.5grms. humin

XVI.—BREWING, WINES, SPIRITS, Etc.

An Improved Method of Aerating and Attenuating Worts and other Liquors, and securing a pure germless Atmosphere wherein to carry on Fermentation. T. P. Chittenden, London. Eng. Pat. 14,868, Dec. 3, 1885. 8d.

A FULL description with drawings of an apparatus for cooling and fermenting beers, worts, and other liquids in closed vessels supplied with germless filtered air; also for aerating and attenuating worts with germ-

TABLE II.

SUBSTANCES TAKEN (IN GRAMMES).				DECOMPOSITION PRODUCTS (IN GRAMMES).			
	Sugar.	Water.	HCl.	Humin Substances.	Unchanged Sugar.	Acetopropionic Acid.	Formic Acid.
Dextrose.....	10.5	50	4.42	0.9	3.07	3.10	1.24
	10.5	50	4.78	1.0	2.73	3.10	1.35
Levulose.....	10.5	50	4.31	2.12	—	3.57	1.72
	10.5	100	5.00	2.12	—	3.84	1.75
	10.5	50	4.87	2.12	—	4.09	1.73

substances, but no acetopropionic acid or any other acid was found. This is contrary to Tollens' experience, who found small quantities of the former acid. Concentrated hydrochloric acid thus acts very differently to dilute acid upon dextrose and other carbohydrates. The duration of the action of heat is also important in determining the nature of the decomposition products, as Soxhlet has already shown. It is important in the preparation of glucose from starch by means of acid, that the acid should not be above 2 per cent. in order to prevent the formation of acetopropionic acid and consequent loss of the carbohydrate.—G. H. M.

free air. The original must be consulted for details of the process and apparatus employed.—G. H. M.

Improvements in the Manufacture of Finings for Sour Beer, Brewers' Waste and Returns. A. W. Gillman and S. Spencer, Southwark. Eng. Pat. 15,063, Dec. 8, 1885. 6d.

THE patentee claims the use of a solution of eutch (catechu) either in water or dilute acids for fining, returns, etc.—G. H. M.

A Combined Eliminator and Filter for Treating Sugar-cane Juice and other Liquids. A. C. Ewing, Glasgow. Eng. Pat. 13,792, Nov. 12, 1885. 8d.

IN the evaporation of sugar-cane juice it is usual to raise the whole of the liquor to a state of ebullition and to filter through filter-bags before allowing it to enter the vacuum pan. To shorten this process a vessel is used in which all the liquor is heated as before to boiling, but only the top part of the liquor containing the scum is allowed to pass over to the filter-bags, the main portion of the clear liquor being drawn off from the bottom of the "blow up." This liquor mixes with the filtrate from the bags, and the whole is then taken into the vacuum pan. Diagrams and description of special plant required are given.—A. J. K.

The Improved Utilisation of Lime and other Calcareous Material Impregnated with Saccharine Matter. A. G. Wass, Bermondsey. Eng. Pat. 9992, Aug. 4, 1886. 6d.

LIME and calcareous matter which has been used in the filtration of sugar gradually becomes unfit for use, and forms a waste product which it is the object of this patent to utilise. The calcareous material impregnated with sugar and other organic impurities is heated in a closed kiln until all the organic matter is carbonised. The mass is then allowed to cool in the absence of air, and the resulting black material is found to be useful for various purposes, such as forming the body of blacking, paint, or ink; also as a disinfectant and as a fertiliser or manure. A convenient temperature for obtaining a good black is found to be about 900° F. By using a lower temperature, or by admission of a little air, amber and grey colours are respectively obtained.—A. J. K.

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, Etc.

(A) CHEMISTRY OF FOODS.

Improvements in a Method of Preserving Animal and Vegetable Food and Liquids. B. H. Thwaite, Liverpool. Eng. Pat. 14,552, Nov. 27, 1885. 6d.

IN this specification reference is made to Eng. Pat. 16,565, 1884, certain modifications having been introduced by the inventor.—E. G. C.

Improvements in the Preservation of Alimentary Substances, and in Apparatus therefor. V. Tribouillet and E. Husson, Paris. Eng. Pat. 15,599, Dec. 18, 1885. 8d.

VESSELS containing the alimentary substances to be preserved are heated by means of injected steam or heated gas.—E. G. C.

(B) SANITARY CHEMISTRY.

Improved Means and Appliances connected with the Separation of Liquids from Sewage and like Matters, in what are termed Filter-presses. J. A. Drake and R. Muirhead, Maidstone. Eng. Pat. 15,402, Dec. 15, 1885. 6d.

THE filtering medium described in Eng. Pat. 10,143, Aug. 27, 1885, by the same authors, and which consisted of cocoa-nut fibre, coir or bass, is rendered more adapted to the purpose by being coated or incorporated with a porous material—e.g., sand, burnt clay, powdered bricks, or charcoal. This may be retained within the filtering mat by coating the plates with tar, or adhesive substances, by scouring their surfaces or providing projections thereon.—C. C. H.

Improvements in the Method of Treating Sewage and other Polluted Waters. J. Bannehr, Devon. Eng. Pat. 8874, July 7, 1886. 8d.

THE coarser matter is first separated from the sewage by a fixed screen, the more finely-divided suspended matter being afterwards separated by a sloping screen, the meshes of which are kept free by a reciprocating frame of triangular bars. The sludge falls therefrom into a receiving well, from which it is pushed by a scraper into a dewatering chamber provided with mechanical rakes, where it is dried by a current of hot air passing over the surface and steam heat from below. The partially clarified sewage is filtered through cells, the walls of which are formed of carbonised sawdust.

—C. C. H.

Improvements in the Manufacture of Filtering Media for use in the Purification of Liquids and Gases. F. Candy, Middlesex. Eng. Pat. 1793, Feb. 6, 1886. 6d.

IRONSTONE having combined carbon in its constitution is heated in a suitable vessel, kiln or chamber, air not being allowed free access to the interior thereof. When vapour ceases to pass off, and the gases have been nearly or quite driven off, the chamber and contents are allowed to cool, and the carbonised ironstone is now disintegrated, if necessary. —E. G. C.

Improvements in the Manufacture of Filtering Materials and Precipitants. Frank Candy, Middlesex. Eng. Pat. 2517, Feb. 20, 1886. 6d.

THE filtering material is manufactured by granulating carbonised natural mixtures of clay and carbonaceous matter, removing iron and alumina therefrom by boiling the granules in mineral acid, separating them from the acid, and rinsing and boiling them with water, in order to remove any absorbed acid and salts produced. The precipitant consists of a powder made by mixing together the pulverised "carbonised material" and an acid liquor containing iron and alumina, and boiling the mixture to dryness. —E. G. C.

Improvements in the Utilisation of Blood from Slaughter Houses in and for the Preparation of Food and Drink for Man and Cattle, and other Animals. H. P. Madsen, Middlesex. Eng. Pat. 10,995, Aug. 28, 1886. 4d.

THE blood fresh from the animal is treated with salt and saltpetre, with or without ginger, while stirring, and then filtered. In the preparations of food from blood, the cleansed blood, mixed with albumen or not, is exposed to heat for the purpose of producing blood-meat. Various improved foods can be made from the cleansed blood and blood-meat, here referred to. —E. G. C.

Improvements in Machines for Drying and Powdering Blood, Town Sewage, or other Material. A. Forest and W. Welsh, Manchester. Eng. Pat. 11,409, Sept. 8, 1886. 6d.

THE improvements consist of flexible springs attached to the revolving arms of cylindrical drying machines with scrapers attached. —E. G. C.

The Application and Use of Carbon in the Compression of Sewage Sludge. G. H. Leane, Westminster. Eng. Pat. 11,820, Sept. 17, 1886. 4d.

THE patentee proposes to substitute porous carbon, such as is manufactured from Kimmeridge shale, for the caustic lime at present used to render sewage sludge pressable. From 2 to 4 cwt. of carbon is sufficient to treat one ton of compressed sludge. —C. C. H.

A Treatment of Excreta and Sewage Sludge for Production of Manure. J. H. Barry, Clapton. Eng. Pat. 11,883, Sept. 18, 1886. 4d.

THE liquid part of the sludge is first separated by filtration in a tall tank having a porous bottom, or by means

of a centrifugal machine; it is then distilled to separate the ammoniacal products. The liquid residue from distillation is treated with lime, and the precipitated matters settled out; the effluent is purified by filtration through charcoal or earth. The solid matter separated from the sludge is then incorporated with the ammoniacal stillate and the precipitate from the lime treatment, and the whole finally dried by exposure on large surfaces to a current of hot air. —C. C. H.

XVIII.—ELECTRO-CHEMISTRY.

A New or Improved Process and Apparatus for Separating Compounds of Metals by Electrolysis. L. Elmore, New York. U.S.A. Eng. Pat. 1565, March 27, 1883. 2d.

THIS invention consists in the use of a hollow conducting anode to contain the compound to be operated upon. Thus, if copper, silver and gold are to be separated, the copper and silver will be dissolved, pass through the anode, if porous, and be deposited or precipitated in the outer cell. If the anode is not porous, the dissolved copper and silver are withdrawn by suitable means and separated in any of the ordinary ways. —E. T.

An Improved Method of and Apparatus for the Working of Metals and Metalloids by the Direct Application of Electric Currents. N. de Benardos and S. Olzowski, St. Petersburg. Eng. Pat. 12,984, Oct. 28, 1885. 1s. 3d.

THIS invention consists in methods of applying the heat of the voltaic arc to various mechanical operations. Thus, if a bar of metal is to be divided, an arc is formed between the metal and a movable carbon pencil; the metal is melted in the path of the pencil, and the bar eventually divided. Methods are described for joining together, riveting, and forging substances; also for coating bodies with different metals and producing metallic inscriptions by the introduction of the desired substance into the arc. —E. T.

A New or Improved Galvanic Battery with Apparatus for Automatically supplying Liquids thereto. W. A. Barlow. From M. Sappey, Paris. Eng. Pat. 13,422, Nov. 5, 1885. 1s. 1d.

THIS invention consists of apparatus, automatically regulated by a system of electro-magnets, for supplying exciting and depolarising liquids to a specially constructed galvanic battery. —B. T.

Improvements in Voltaic Batteries. J. P. Rees and T. D. C. Parker, London. Eng. Pat. 13,694, Nov. 10, 1885. 8d.

TO counteract the effects of endosmose, porous pots provided with overflow spouts are used, the superfluous liquid flowing away by means of these spouts into a suitable receptacle. The porous pots and zinc plates are so supported as to be capable of being lifted out of the exciting liquid when the battery is not working. —B. T.

An Improvement in Manganese Voltaic Batteries. B. Pell, London. Eng. Pat. 15,285, Dec. 12, 1885. 4d.

IN manganese cells as at present constructed, agglomerated blocks present only a small surface, while porous cells are apt to break or become clogged. The inventor therefore confines granules of carbon and manganese in a vessel pierced with small holes or slits, which allow free passage of the liquid only. —E. T.

Improvements in Cells for Generating Electricity by means of Hydrogen. J. A. Kendall, Middlesborough. Eng. Pat. 15,105, Dec. 9, 1885. 8d.

INSIDE the electrodes or metallic tubes is placed a core of porous material which will resist the heat at which

the battery is worked. Cores may be constructed from almost any fire-resisting earthy matter not reducible by hydrogen at the temperature employed.—B. T.

Improvements in Primary Electric Batteries. G. F. Rose, London. Eng. Pat. 7028, May 25, 1886. 6d.

IN this battery, which is a double-fluid one, the outer cell contains one or more carbon electrodes in a solution of bichromate of potash and sulphuric acid, and the porous cell the zinc electrode in neutral or acidulated water. The zincs are attached by cords to a roller provided with a handle, which, when turned, withdraws them from the liquid; the roller is retained in position by a ratchet and pawl. A layer of mercury is sometimes added in the porous cell.—E. T.

Improvements in Primary and Secondary Batteries. P. Bailly, Ermont, France. Eng. Pat. 11,823, Sept. 17, 1886. 8d.

ELECTRODES are formed of masses of lead wool bound together by strips of lead cut at the sides to produce fringes. The latter lessen the internal resistance, and avoid the necessity for numerous soldered joints where several electrodes are used. To prevent the straps being eaten through at the surface of the liquid, they are in some cases brought out at the sides. When zinc electrodes are employed, they are in the shape of a stiff amalgam dipping into a little mercury. The electrodes may be used in various positions and, if required, separated by various porous bodies. The containing cell consists of one vessel inside another, from which it is separated by a material not acted upon by acids.—E. T.

A New and Useful Composition of Matter to be used as an Electric Battery Excitant. E. D. Kendall, Brooklyn, U.S.A. Eng. Pat. 10,536, Aug. 17, 1886. 4d.

THIS composition, termed "Solid Battery Excitant," consists of a bi-sulphate or bi-sulphates of an alkali or alkalis, or sulphuric acid, or both, in combination with chromic acid. The composition may be conveniently prepared by mixing together bichromate of potash and sulphuric acid.—B. T.

XIX.—PAPER, PASTEBOARD, Etc.

Improvements in the Construction of Boilers or other Vessels used in the Conversion of Woody or other Fibres into Pulp for the Manufacture of Paper or other Articles prepared from Pulped Fibres. A. McDougall, Penrith. Eng. Pat. 4569, April 14, 1885. 6d.

To obviate the inconveniences, by the use of lead-lined iron or steel boilers, in consequence of the unequal expansion and contraction of the two metals by alternate heating and cooling, the boilers are constructed, according to this invention, with a packing of felt or other elastic and compressible material between the interior leaden vessel and exterior iron or steel jacket. When the interior leaden vessel is expanded by heat and steam pressure the compressible packing yields to such expansion. Also, in the cooling, the packing prevents rupture of the lead. The compressible packing may be composed of caoutchouc, felt, flocks, coir, cork, asbestos, etc. Another improvement consists in the construction of the outer iron or steel vessel in flanged sections, drawn together and fixed in position over the packing surrounding the leaden vessel by screw bolts or other suitable means.—W. D. B.

Improvements in the Manufacture of Pulp or "Half-Stuff," utilising Waste or Refuse Materials. F. G. Morton and N. Salamon, London. Eng. Pat. 13,022, Oct. 29, 1885. 6d.

THIS invention relates to a method of preparing pulp by boiling waste vegetable fibres such as jute, gunny, etc.,

previously leased out by any suitable machinery, in weak alkaline lyes at atmospheric pressure, and subsequently bleaching with calcium hypochlorite.

—E. J. B.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Preparation of Vanillin from Metachloroparanitrobenzaldehyde. L. Landsberg. Dingl. Polyt. J. 262, 139.

IT is proposed to convert metachloroparanitrotoluene into chloronitrobenzyl chloride or bromide, and treat the latter with lead or copper nitrate in order to obtain metachloroparanitrobenzaldehyde. On treating this aldehyde with an alkaline methylate or hydroxide dissolved in methyl alcohol, the chlorine is replaced by the methoxyl group, with formation of metamethoxyparanitrobenzaldehyde. The same compound is obtained when the chlorine in metachloroparanitrobenzaldehyde is replaced by hydroxyl, and the resultant hydroxynitrobenzaldehyde is converted into its methyl ether. Metamethoxyparanitrobenzaldehyde crystallises from boiling water in white needles, melting at 62°, and is converted into vanillin according to the known methods. When treated with acetic anhydride or sodium acetate, it is resolved into metamethoxyparanitrocinnamic acid, melting at 218°.—D. B.

Some Derivatives of Kairin. C. A. Kohn. Inaug. Dissert. Erlangen, 1886.

THE ammonium iodide addition product of hydroxyhydroxymethylquinoline gives, on treatment with solid caustic potash, methoxyhydroxymethylquinoline. The action of the caustic alkali is, in the first place, to form the potassium salt of hydroxyhydroxymethylquinoline, which then undergoes an atomic displacement, when potassium iodide is removed, and the added methyl group replaces the potassium in the hydroxyl, forming the methyl ether of the original compound. Similarly hydroxyhydroxymethylquinoline ethiodide yields ethoxyhydroxymethylquinoline previously obtained by Otto Fischer. Both the above compounds combine readily with alkyl iodides, forming crystalline bodies, which, when treated with moist silver oxide, yield the corresponding ammonium bases. These behave quite normally on heating.

Benzyl chloride also forms an addition product with kairin, which is decomposed by caustic potash, with the formation of a substance which was proved, by treating hydroxyhydroxymethylquinoline with benzylchloride, to be the benzyl ether of kairin; thus proving that by the action of caustic alkali on the kairin ammonium iodides it is actually the added group that undergoes displacement.

Kairin treated with sodium acetate and acetic anhydride yields acethydroxyhydroxymethylquinoline (acetyl kairin), a body possessed of feebly basic properties, on which account it was of no value as an antipyretic. The physiological properties of benzoyl kairin were not investigated, for a similar reason. Hydroxyhydroxymethylquinoline heated with ethylene bromide in closed tubes gives hydroxyhydroxymethylquinoline, a body in which two quinoline groups are linked together by the bivalent residue—CH₂—CH₂—. It is a white crystalline substance, both the acid and basic properties of which are weak. The physiological action of this body, owing to its constitution approaching that of the quinine alkaloids somewhat more closely than that of kairin does, is of interest. It acts as a febrifuge, but its action is far weaker than that of kairin—a fact due, in all probability, to its feebler basic properties. It appears that the relative activity of these febrifuges bears a due proportion to their basicity.

Of many kairin derivatives prepared since the discovery of this body by O. Fischer (1881), none have proved of greater efficiency as antipyretics than kairin itself. Kairin has been applied with success as a febrifuge, and is still employed as such. The introduction of antipyrin has, however, greatly restricted its use. The advantage to be claimed for kairin is that it reduces the temperature

of the body more rapidly than antipyrin, and, therefore, is of special value in extreme cases in which the latter would be of less avail.—C. A. K.

Some Substances contained in the Root of Hydrastis Canadensis. M. Freund and W. Will. Ber. 19, 2797—2803.

PERRINS described an alkaloid which he found together with berberine in the root of *Hydrastis canadensis*, and named *hydrastine*. The authors prepared this substance by extracting the finely-powdered root with ether, evaporating off the ether, and dissolving the residue in hot alcohol. On cooling, the alcoholic filtrate deposits hydrastine in a pure state. Hydrastine forms crystals belonging to the rhombic system, melting at 132°. On analysis it gave numbers agreeing with the formula $C_{22}H_{23}NO_6$.

Hydrastine acted upon by methyl iodide yields a crystalline compound, melting at 208°, and having the composition $(C_{22}H_{23}NO_6)CHI_3$. Decomposed with moist silver oxide, it gives a body crystallising in small brilliant crystals, melting at 236—238°.

On oxidation with an acid solution of potassium permanganate, hydrastine yields an acid agreeing in all respects with opianic acid.

When heated with nitric acid of 1.3 sp. gr., hydrastine yields a mixture of opianic acid, and a base which greatly resembles cotarnine in its properties. The authors consider, from the behaviour of hydrastine with various reagents, that it is closely related to narcotine.

By treating the residue remaining after separation of berberine and hydrastine with sulphuric acid, and then with ether, a neutral substance, not containing nitrogen, was obtained, which crystallises in fine needles, melting at about 100°.—G. H. M.

Manufacture of Salol. By Dr. Hugo Eckenroth. Arch. der Pharm.

IN a recent number of the *Pharm. Zeit.*, a process for the manufacture of salol was described by Mr. B. Fischer. In studying that process it occurred to the author that phosgene (carbonylchloride, $COCl_2$) would be a much better medium for the preparation of salol. This body is a gas at ordinary temperatures, and may be prepared in various ways, but most practically by passing carbonic oxide through a boiling solution of antimony or phosphorus pentachloride.

Phosgene readily parts with its chlorine; for example, in the preparation of ethylene chloride from aldehyde:— $C_2H_4O + COCl_2 = C_2H_4Cl_2 + CO_2$. Another phase of its action is seen in the decomposition which acetate of sodium undergoes when a stream of the gas is passed through it. Here the acid is reduced to the anhydrous state, as will be seen from the following equation:— $2NaC_2H_3O_2 + COCl_2 = 2NaCl + (C_2H_3O_2)_2O$.

Similarly alcohols are reduced to ethers by phosgene; for example, ethyl alcohol reacts as follows, yielding ethyl chlorocarbonate:— $C_2H_5OH + COCl_2 = C_2H_5OCOC_2H_5 + HCl$; while phenol is decomposed by liquid phosgene into phenyl carbonate, thus:— $2C_6H_5OH + COCl_2 = C_6H_5O.CO.OC_6H_5 + 2HCl$. The application of phosgene to the preparation of salol is based upon the following reaction, which takes place when the gas is passed through a mixture of salicylate and phenate of soda:— $C_6H_4 \begin{smallmatrix} OH \\ COONa \end{smallmatrix} + C_6H_5ONa + COCl_2 = HIO.$

$C_6H_4.CO.OC_6H_5 + 2NaCl + CO_2$. In practice molecular proportions of salicylate and phenate of soda are intimately mixed and placed in a flask provided with a well-fitting indiarubber stopper with two holes in it—one for a tube through which phosgene may be conveyed, the other for an exit tube about seven feet long. The gas being slowly passed in, the beginning of the reaction is manifested by a considerable rise in temperature, which, however, falls speedily; and it is necessary, in concluding the operation, to heat the contents of the flask on a water-bath. The completion of

the reaction is known when a small portion of the contents shows, on testing, freedom from phenol. After this the contents of the flask are further heated on the water-bath for twelve hours; then washed free from sodium chloride by means of water, the salol being purified by repeated crystallisation from alcohol, whereby it is obtained in tabular crystals, melting at 40°. When boiled with a caustic alkali it yields abundance of salicylic acid after the resulting solution is acidified.

Bromine water precipitates the salol from alcoholic solution in the form of long needles, which the author determined to be those of a bromo-derivative. He dissolved salol in five times its volume of absolute alcohol, and added to the solution bromine in small quantities at a time, each portion being allowed to combine before another was added, until a yellow tint—which did not disappear in a short time—was imparted to the liquid. After ten hours, crystals of a bromo-derivative, $C_{11}H_9O_3Br$, were obtained and purified by crystallisation from alcohol. Thus the compound was obtained in beautiful white silky needles, melting at 98.5° C. (uncorr.). The body is insoluble in water, difficultly soluble in cold, but easily soluble in boiling alcohol and ether. The author continues his study of the bromo-derivatives of salol, as well as the action of phosgene in the production of other "salols."

Improvements in the Manufacture of Lactic Acid and Lactates. A. G. Brookes, London. From F. S. Nowell, Boston, U.S.A. Eng. Pat. 14,001, Nov. 17, 1885. 6d.

THE invention has for its object the production of a lactic ferment and crude lactates practically pure from other ferments, and consists in cultivating lactic ferments in media specially favourable to the growth of lactic ferment, but less favourable to the growth of other ferments, such as butyric, alcoholic, etc.

A medium favourable in the highest degree for lactic fermentation is composed of 1000 parts starch sugar, dextrin or glucose or milk sugar, 6000 parts of water, 500 parts carbonate of lime, and 100 parts vegetable nitrogenous matter kept at 95 to 113° F.—T.

New Compounds of Organic Alkaloids and Saccharine and Method of producing the same. C. Fahlberg and A. List. Eng. Pat. 596, Jan. 14, 1886. 6d.

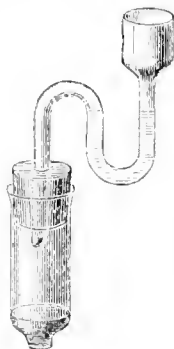
THE object of the process covered by this patent is to render certain alkaloids of objectionable taste—such as quinine, strychnine, and morphine—more palatable. This is effected by making an aqueous or alcoholic solution of saccharine (benzoyl sulphonic imide, Eng. Pat. 6626, 1885), and neutralising the solution by the addition of the alkaloid of which a compound is desired. The solution so formed yields the compound in an amorphous or crystalline condition on evaporation; but if an excess of saccharine is used, an easily crystallisable acid-salt of the alkaloid is produced, which possesses in a still less degree the characteristic taste of the alkaloid.

XXI.—EXPLOSIVES, MATCHES, Etc.

The Analysis of Explosives. G. Lunge. Chem. Ind. 1886, 273.

THIS paper commences with a brief review of the various methods which have recently been proposed for the estimation of nitrogen in organic nitro-compound explosives; and the author points out that whilst the original form of his nitrometer was perfectly applicable to the analysis of liquid nitro-compounds, or to nitrates and nitrogen oxides in solution, it could not be conveniently employed for the nitrogen assay of solid bodies, such as gun-cotton or kieselguhr dynamite, especially when such contained carbonates, as in this case the nitric oxide would be contaminated with carbonic acid. The author now proposes

a simple modification (see illustration), which renders the nitrometer capable of application to the analysis of solid nitro-compound explosives, even when they contain carbonates in admixture. The mouth of the nitrometer cup is closed with a perforated caoutchouc stopper, through which passes a small thistle-headed funnel, bent twice upon itself. The end of the funnel tube projects a short distance into the cup, and is ground obliquely. For the actual performance of the analysis, the weighed quantity of substance is introduced into the cup, the caoutchouc stopper inserted, and 2 to 3cc. of concentrated sulphuric acid passed in through the funnel. By this procedure,



a few drops of acid naturally remain in the bend of the funnel, and retain any nitrous fumes which might be evolved. When solution of the substance is effected, the liquid in the cup is drawn into the nitrometer in the usual way, the cup is once washed out by passing a small quantity of acid through the bent funnel, the stopper then removed, and the rinsing of the cup completed in the usual manner. The analysis is then proceeded with in the usual way. Working under such conditions, it is clear that the presence of carbonic acid can have no vitiating effect upon the results. Tested according to this plan, a sample of collodion cotton yielded the following figures:—

I.	12.09	per cent.	Nitrogen.
II.	12.07	"	"
III.	12.05	"	"

In I. the whole of the acid for solution and for washing was introduced through the funnel; in II. and III. the small portions of substance, resting on the sides of the cup, were washed down with acid. The cup then closed, and the main portion of acid introduced through the funnel. The rinsing out of the cup was effected whilst the cup was open. The results show that the simpler manipulation adopted in II. and III. gives as accurate results as that in I.—W. D. B.

Improvements in the Treatment of Explosive Compounds.

H. E. Newton, London. From Alfred Nobel, Paris. Eng. Pat. 5852, April 28, 1885. 4d.

THE object of this invention is to render nitro-glycerine comparatively safe and inexplosive while it is stored. For this purpose methylic alcohol was employed, but owing to the volatility of that liquid, the protection obtained was not sufficient. The present improvement consists in diluting nitro-glycerine with solvents, which are non-volatile or only slightly volatile, whereby a practically inexplosive mixture is obtained. Of such solvents common tar oil, that distilling above 200° C., is employed by preference, the mixture being made in the proportions of 100 parts of nitro-glycerine to 50 parts of the tar oil. When it is required to restore to the nitro-glycerine its explosive properties, about 100 parts by weight of oleic acid are added to the above mixture, and the whole well shaken. Or in place of oleic acid, petroleum, carbon bisulphide or other liquid, in which tar oil is soluble, and nitro-glycerine insoluble, may be used. The nitro-glycerine is precipitated, together with a small percentage of tar oil, which it retains, but which for many purposes is not detrimental, as it lessens the sensitiveness to concussion of the nitro-glycerin.—W. D. B.

Improvements relating to the Manufacture of Explosive Compounds. H. S. Maxim, London. Eng. Pat. 6926, June 8, 1885. 6d.

THE object of this invention is the preparation of an explosive mixture less liable than ordinary gunpowder to be affected by moisture, and capable of being compressed or moulded into prisms or blocks, having a more regular density throughout than is the case with compressed forms of ordinary gunpowder. A mixture of the following ingredients, in or about the proportions specified—viz., 78.18 parts of potassium nitrate, 11.42 parts of paraffin wax, and 10.40 parts of sulphur, is prepared by first incorporating the potassium nitrate and sulphur in the usual manner, and then adding the paraffin in the molten condition. The resulting mixture may be employed alone, or better in conjunction with gunpowder or gun-cotton. By incorporating one part of the mixture with three parts of gunpowder, a compound is obtained which can be readily moulded under pressure, since it flows in the press like wax, and which yields forms or prisms less liable than gunpowder to be injuriously affected by rough handling or moisture.

—W. D. B.

Improvements in the Manufacture of Explosives. D. Johnson, London. Eng. Pat. 8951, July 24, 1885. 8d.

NITRO-CELLULOSE explosives in the granular or compressed form are treated with camphor in solution. The solvents employed are such as boil below 100° C., such, for example, as petroleum ether. The explosive is saturated with the camphor solution, the solvent volatilised at as low a temperature as practicable, and the grains, cylinders, prisms, or other forms of the explosive, now containing finely-divided camphor, disseminated through their mass, are subjected in a closed, though not necessarily an air-tight vessel, to a temperature not exceeding 100° C. Between 50° and 100° C. the camphor exerts a remarkable gelatinising action upon the nitro-cellulose, and the grains or other forms become hard and tough. The camphor having effected the requisite amount of hardening, may either be driven from the explosive by heat and condensed for repeated use, or it may be washed out by any appropriate solvent. In proportion to the amount of camphor employed, the nature of the explosive may be regulated at will, this not being due to the presence of camphor in large or small amounts in the finished products, but to the gelatinising action of the camphor upon the nitro-cellulose at the temperatures stated. The camphor treatment provides a means whereby the grains or other forms of the nitro-cellulose explosive are hardened uniformly throughout their mass and not simply at the surface, so that as regards burning or explosion the action is uniform throughout. Moreover, the grains still retain at the surface their microscopically fibrous structure, whereby a number of minute points is presented to the flash of the cap, and free ignition thus brought about. The invention may be employed in the preparation of explosives for use in sporting and military small arms and in ordnance.—W. D. B.

An Improved Explosive Compound for Guns or Firearms and Blasting Purposes. C. D. Abel. From F. Gaens, Hamburg, Germany. Eng. Pat. 14,412, Nov. 24, 1885. 6d.

“THIS invention relates to an improved explosive compound for guns or firearms and blasting purposes, similar to ordinary gunpowder, in which, in place of the sulphur, an ammonium salt is employed in combination with saltpetre in such proportions that on ignition a compound of potassium, nitrogen and hydrogen, termed potass-amide, is formed, which is volatile at high temperatures and which increases the useful effect of the explosive and burns without residue. The composition and action of this explosive, which is termed ‘Amide powder,’ is expressed, for example, in the application of nitrate of ammonia, by the formula $\text{KNO}_3 + \text{H}_2\text{N}(\text{NO}_2) + 3\text{C} = \text{KH}_2\text{N} + \text{H}_2\text{O} + \text{CO} + 2(\text{CNO}_2)$. The amide KH_2N is potassium nitride combined with ammonia for $3\text{KH}_2\text{N} = \text{K}_3\text{N} + 2\text{H}_3\text{N}$.”

The manufacture of this powder is the same as that of ordinary gunpowder, and where deemed advisable other nitrates may be substituted for that mentioned, and salts of ammonia other than the nitrate may be employed, so long as the composition is such that amide compounds are produced in the process of combustion.

—W. D. B.

Improvements in the Manufacture of Gunpowder and similar Explosives. E. Schultze, Germany. Eng. Pat. 15,129, Dec. 9, 1885. 6d.

THE inventor prepares a sporting powder by mixing 12 parts of nitrified tar, colophony, turpentine or turpentine oil, or mixtures of same, with 60—80 parts of pyroxylin, 60—80 parts of barium nitrate, 8—10 parts of potassium nitrate, granulating as usual. The grains of the finished powder may be coated with paraffin, resin, or collodion.

A rifle powder is prepared by mixing 10 parts of nitrified tar, colophony, turpentine or turpentine oil, or mixtures of same, with 280—300 parts of pyroxylin, 100—120 parts of barium nitrate, 40—50 parts of potassium nitrate, and 10 parts of sulphur. Explosives for blasting purposes are prepared by increasing the amount of pyroxylin. The claims are for the use of nitrified "hydrocarburets," such as nitrified tar, colophony turpentine or turpentine oil in conjunction with pyroxylin, nitrates, and sulphur in the preparation of explosives for propelling and rending purposes.—W. D. B.

A New Explosive, Processes of Preparing and Using the same, Primings therefor and Shell charged therewith. A. M. Clark. From E. Turpin, Paris. Eng. Pat. 15,089, Dec. 8, 1885. 8d.

THE inventor claims as novel the employment of picric acid alone, without any admixture of oxidising agents, moulded by compression or heat into compact blocks or masses.—W. D. B.

Improvements in Fuses for Explosive Shells and Torpedoes. E. L. Zalinski, Washington, U.S.A. Eng. Pat. 6340, May 11, 1886. 8d.

THIS is an improvement upon Eng. Pat. 2826, March 3, 1885, and consists in the arrangement of an electric battery in a shell or torpedo by which the charge is exploded; in the mechanism by which the electric battery is held out of action until the desired time for firing, and in the method in which the same is brought into play either on impact or as a time fuse. Arrangements are also described by which the shell or torpedo explodes when in contact with water or immersed therein, the battery contained in the shell or torpedo being put up in the dry and inert state and remaining inactive until the ingress of water has taken place.

—W. D. B.

Improvements in Explosive Compounds. Hermann Scheneweg, Dudweiler, Germany. Eng. Pat. 6664, May 18, 1886. 4d.

To prepare a mixture which can only be exploded by a very powerful initial detonation the inventor compounds 218 parts of di-nitronaphthalene with 720 parts of ammonium nitrate. For use with less powerful detonators, there may be substituted for the di-nitronaphthalene two parts of dinitrobenzene mixed with five parts of ammonium nitrate. The claims are as follows:—

1. The production of explosive compounds consisting of mixtures of di- or tri-nitrobenzene, or di- or tri-nitronaphthalene with ammonium nitrate.

2. The mode of regulating the action of the explosive compound referred to in the preceding claim by mixing together two or more of the compounds, consisting of ammonium nitrate with one or other of the nitro-derivatives there enumerated.

3. The use, in combination with the explosive compounds referred to in the preceding claims, of nitrated resin for the purpose of protecting them against moisture and increasing their durability.—W. D. B.

XXII.—GENERAL ANALYTICAL CHEMISTRY.

Congo-red as an Alkalimetric Indicator. P. Julius. Chem. Ind. 9, 109.

CONGO-RED dissolves in water and alcohol with a red colour, changing into blue by acids, and which is again turned to red by alkalis. The author recommends its use for the titration of aniline and its homologues, especially for the mixture of aniline and toluidine, known as the "échappés" of aniline colour works. The échappés is completely dissolved in water, a few drops of an alcoholic Congo-red solution added, normal hydrochloric or sulphuric acid being used for the titration, until the red colour changes into a bluish-violet, which point can be clearly distinguished. Commercial "aniline-oil for blue" was used for the following experiments. In Nos. 1 to 4 the water added was not sufficient for dissolving all the aniline; in Nos. 5 to 8 all the aniline was dissolved in water:—

No.	Amount of Aniline used.	cc. of Normal HCl used.	Amount of Aniline found.	Difference.
1	0.9242	9.9	0.9207	-0.0035
2	1.7656	19.0	1.7670	+0.0014
3	1.0680	11.5	1.0694	+0.0014
4	1.1510	12.4	1.1532	+0.0022
5	3.5894	38.5	3.5805	-0.0089
6	2.6512	28.6	2.6598	+0.0086
7	3.6906	39.8	3.7011	+0.0105
8	2.6799	28.8	2.6784	-0.0015

—S. H.

Detection of Small Amounts of Hydrocyanic Acid. G. Portmann. Monatsh. f. Chem. 7, 416.

THE reaction depends upon the formation of sodium nitroprusside by the action of a nitrite in acid solution on potassium cyanide and a ferric salt (Playfair). The process is carried out as follows: The liquid to be tested for hydrocyanic acid is treated with some drops of a potassium nitrate solution, from two to four drops ferrous sulphate solution and so much dilute sulphuric acid, until the yellow-brown colour of the basic ferric salt formed is just changed into a light yellow. The liquid is then heated to a boil and afterwards allowed to cool. The iron in excess is precipitated with a few drops of ammonia, filtered, and the filtrate tested with one or two drops of dilute colourless ammonium sulphide. If hydrocyanic acid was present in the original solution, the liquid at once assumes a violet colour, which changes in a few minutes into blue, then green, and finally into yellow. Very minute traces of hydrocyanic acid produce a bluish-green colour, which soon changes into greenish-yellow. 0.000032 grms. hydrocyanic acid in 10cc. of water can still be thus detected.—S. H.

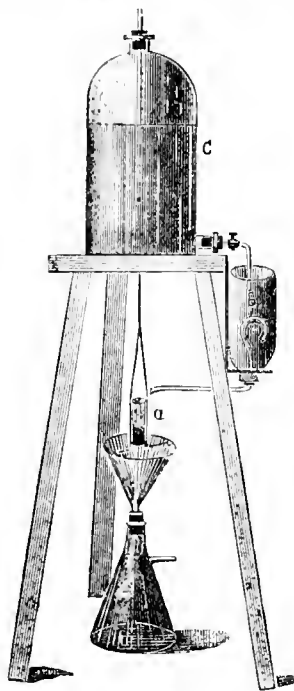
The Titration of Soda in the presence of Alumina, and of Vanadic and Tungstic Acids. E. B. Zeits. Anal. Chem. 25, 186.

A COMMERCIAL CARBONATE of soda which contains alumina, on titration with acid, using dimethyl-orange as indicator, will be shown to contain too much sodium carbonate when the titration is carried slowly to the point of permanent redness, the error amounting to 53 of sodium carbonate for every 17 of alumina. For example, a rather impure soda, especially Leblanc-soda, containing one per cent. of substances insoluble in water, of which one-half is alumina, 1.5 per cent. too much soda will be found, if, as is generally the case, the insoluble matters be not removed.

Sodium carbonate containing vanadium, when treated as above, gives a brown colouration; the red colour does not appear until there is a considerable excess of acid. Litmus paper must be used in this case. Tungstic acid acts similarly, but such varieties of soda very seldom occur in commerce.—W. S.

Automatic Washing Apparatus. R. Lucien. *Chem. Zeit.* 10, 1272.

THE essential part of the apparatus is a hydraulic, radiating cross α , suspended by a thread above the funnel, through which the water passes before it reaches the funnel. The cross is fed with water by the aid of a



lever b , with intermittent action, the water being supplied from a Mariotte's bottle c . The accompanying drawing illustrates the apparatus. The flow of water is said to be easily regulated.—D. B.

ERRATUM.—In the November number of this Journal, page 618, second column, article on the *Determination of Phenol in Crude Carbolic Acid*, in the 5th line from end of abstract, for "10cc. iodine solution is added," read "10cc. of potassium iodide solution are added."

New Books.

MANUAL OF PRACTICAL PHARMACEUTICAL ASSAYING, including Details of the Simplest and Best Methods of Determining the Strength of Crude Drugs, and of Galenical Preparations. Designed especially for the use of the Student and of the Practical Pharmacist. By A. B. LYONS, A.M., M.D. Detroit: D. O. Haynes & Co., Publishers. 1886. London: H. Grevel & Co., Foreign Booksellers, 33, King Street, Covent Garden.

SMALL 8VO VOLUME bound in cloth, containing Preface, Table of Contents, 146 pages of subject-matter, and an Appendix of 5 pages, with tabulated results of considerable value of assays of some of the more important vegetable drugs. The work contains eleven excellent woodcuts, and taken in detail it treats of the apparatus needed in the process described; the reagents; general methods for the assay of crude drugs; methods of extracting alkaloids from crude drugs; general assay processes; the use of Mayer's reagent; gravimetric estimation of alkaloids; assay of Galenical preparations; special methods of separating alkaloids in a state of purity; separation of alkaloids from one another by solvents; Parson's scheme of proximate analysis; estimation of alcohol in fluid extracts, etc.; estimation of glycerine in fluid extracts, etc.; aconite and its pre-

parations; assay of commercial aconitine; belladonna and stramonium and their preparations; cinchona bark and its preparations; assay of cinchona alkaloids; estimation of quinine in mixed alkaloids from cinchona bark; coca and its preparations; colchicum and its preparations; conium and its preparations; digitalis and its preparations; elaterium; gelsemium and its preparations; guarana, coffee and tea, and their preparations; hydrastis and its preparations; hyoseynus and its preparations; ipecacuanha and its preparations; nux vomica and Ignatia bean and their preparations; opium, physostigma, pilocarpus, podophyllum, Quebracho bark and their preparations; rhubarb; tobacco; veratrum virides; amyl nitrite; ethyl nitrite; peptone and pepsin.

A TREATISE ON CHEMISTRY. By Sir H. E. ROSCOE F.R.S., and C. SCHORLEMMER, F.R.S., Professors of Chemistry in the Victoria University, Owens College, Manchester. Vol. III.: The Chemistry of the Hydrocarbons and their Derivatives; or, Organic Chemistry. Part III. London and New York: Macmillan & Co. 1886.

8VO VOLUME, bound in cloth, containing 372 pages of subject-matter, and an alphabetical index covering nearly 14 pages. As stated in the Preface, "This part of the work commences the consideration of the complicated but most important series of bodies known as the aromatic compounds. It contains, after an introduction, a description of the mode of formation, and of the properties of the aromatic hydrocarbons and their derivatives, together with an historical discussion of their isomeric modifications. The constitution of benzene, and the characteristic reactions of its di-substitution products, are then fully explained. Next follows a review of all the important benzene derivatives, so that the part now published forms a complete chapter of the ever-increasing volume of aromatic chemistry." Besides being a work specially designed for the theoretical chemist, its text is sufficiently comprehensive to satisfy the wants of the technologist who seeks for points of departure in the various directions of applicability to the wants of pharmacists, colour chemists, etc. The text is embellished by 14 wood engravings.

The German counterpart of the above volume has also recently appeared under the following title:—"Ausführliches Lehrbuch der Chemie." Vierter Band. Die Kohlenwasserstoffe und ihre Derivate oder Organische Chemie. Zweiter Theil. Erste Abtheilung. Braunschweig. Druck und Verlag von Friedrich Vieweg & Sohn. 1886.

TARIFF CHANGES AND CUSTOMS REGULATIONS.

(From the "Board of Trade" and other Journals.)

CLASSIFICATION OF ARTICLES IN TARIFFS.

RUSSIA.—(Rouble=3s. 2d. Pound=36lb.) Carbonic acid lime, chemically pure, such as purified chalk, section 108, part 2, duty 6 copecks per pound.

SWITZERLAND.—(Quintal=2204lb.) Nitrate of baryta, Category 16, duty 20 centimes per quintal. Ultra-marine (blue for washing) without distinction of package, Category 36, duty 3frs. 50c. per quintal.

MODIFICATIONS IN TARIFFS.

NETHERLANDS.—A law received the royal sanction on the 1st November last, exempting from excise duty foreign varnishes made with methylated spirit.

GREECE.—The duty on cotton tissues, bleached, not classified, will in future be at the rate of 40 per cent. above the duty on unbleached cotton tissues, instead of 25 per cent. as formerly. The duty on dyed and printed cotton tissues will in future be at the rate of 80 per cent. above the duty on unbleached cotton tissues, instead of 60 per cent. as formerly. All the import duties of the revised tariff are payable in gold, or with an increase of 15 per cent. if paid in paper.

ITALY.—It is expected that a duty will be placed on pig iron, now admitted free.

ROUMANIA.—The duty on cement, natural and prepared, to be 60 centimes per 100 kilos.

ECUADOR.—To pay 2d. per kilo:—Common soap, refined table salt, and writing ink. To pay 5d. per kilo:—Olive, castor, and almond oil, varnish, vinegar, matches, paint in powder, and candles.

MEXICAN CUSTOMS TARIFF (Mexican Dollar=4s. 2d.).

No. in Tariff.	ARTICLES.	Kilos.	Dollars.
	Chemicals, Drugs, and Medicines:		
507	Acetates of copper and lead, legal weight*	0	08
508	Acetates of all kinds, not specified, legal weight*	0	15
510	Acids, gaseous or liquid, not specified, legal weight*	0	25
511	Acids in crystal or powder, not specified, legal weight*	1	10
515	Albumen, net weight*	0	30
518	Alcohol or spirits of wine (cognac), net weight*	0	50
516	Alkaloids and their salts, not specified, legal weight*	13	50
520	Alizarin, natural or artificial, gross weight*	0	10
509	Aloes, legal weight*	0	35
524	Ambergris, legal weight*	16	50
525	Antimony, metallic net weight*	0	35
527	Arsenic, net weight*	0	30
528	Atropine, and its salts, legal weight*	27	50
554	Barks, herbs, leaves, flowers, fruits, seeds, and roots, medicinal, gross weight*	0	26
535	Benzene of all kinds, legal weight*	0	10
536	Bicarbonate of potash, legal weight*	0	05
517	Camphor, legal weight*	0	55
541	Cantharides, net weight*	3	00
542	Capsules, medicinal, of all substances, legal weight*	1	65
543	Castoreum, legal weight*	4	70
544	Catechu or cutch, gross weight*	0	10
546	Chloral hydrate, legal weight*	2	90
517	Chlorate of potash, legal weight*	0	08
549	Chloride of gold, legal weight*	27	50
550	Chloride of lime, gross weight*	0	02
548	Chloroform, legal weight*	1	65
551	Cocaine, legal weight*	33	00
552	Collodion and its compounds, legal weight*	1	10
553	Colours, crude or prepared, legal weight*	0	15
555	Cressote, legal weight*	1	25
545	Cyanide of potash (common), legal weight*	0	08
557	Dextrine, legal weight*	0	15
558	Digitaline, legal weight*	27	50
559	Drugs, medicinal, and chemical products, not specified, legal weight*	0	75
580	Dye-woods, in wood or powder, gross weight*	0	05
560	Elaterium, legal weight*	33	00
562	Essences of sarsaparilla, legal weight*	0	35
564	Ether of all kinds, legal weight*	0	20
566	Extracts of all substances for medicinal uses, legal weight*	3	30
567	Extracts of logwood, of Brazil wood, and all dye-woods, gross weight*	0	05
505	Fixed oils, not specified, except olive oil, legal weight*	0	55
570	Glycerine, gross weight*	0	10
571	Gum damar and gum lac, gross weight*	0	10
572	Gums, resins, and bitumens of all classes, for medicine, not specified, gross weight*	0	20
573	Hyposulphite of soda, gross weight*	0	01
526	Indigo of all kinds, gross weight*	1	35
574	Injections, of all substances, legal weight*	0	55
609	Iodine, pure, gross weight*	2	20
519	Lavender, gross weight*	0	06
504	Lined oil, net weight*	0	25
578	Litharge, net weight*	0	15
581	Metals and metalloids for medicinal purposes, not specified, net weight*	3	00
582	Morphine and its salts, legal weight*	11	00
522	Musk, legal weight*	11	00
583	Naphthalene, legal weight*	1	30
584	Nitrate of silver, legal weight*	11	00
585	Opium, gross weight*	2	20
586	Orchil, gross weight*	0	05
589	Pepsine, legal weight*	5	50
590	Pills, pearls, grains, conills, etc., legal weight*	0	65
569	Phosphorus, common or red, legal weight*	1	50

* By legal weight is understood the weight of the merchandise, including that of the inner coverings, such as bottles, boxes, wrappers, etc.

No. in Tariff.	ARTICLES.	Kilos.	Dollars.
593	Chemicals, Drugs, and Medicines:		
591	Prussiate of Potash, legal weight*	0	08
594	Pyrolignite of iron and lead, legal weight*	0	08
529	Quinine and its salts, net weight ..	1	00
596	Saffron (Spanish), dry or in oil, net weight ..	4	20
595	Salicine, net weight ..	1	00
597	Salts and sulphates, of all substances, excepting those specified, legal weight*	1	16
599	Saltpetre, gross weight ..	0	01
575	Soda caustic, gross weight ..	0	08
514	Soaps, medicinal, gross weight ..	0	30
521	Spirits of turpentine, gross weight ..	0	10
563	Starch (washing), gross weight ..	0	08
600	Strychnine and its salts, legal weight*	13	20
531	Sulphate of copper, gross weight ..	0	01
523	Sulphur, gross weight ..	0	01
601	Tar of pitch (resin), gross weight ..	0	04
534	Tartar, cream of, crude, legal weight*	0	08
606	Varnishes of all kinds, legal weight*	0	18
537	Veratrine, legal weight ..	8	80
657	Whiting, dry, gross weight ..	0	02
658	Soap, common, not perfumed, gross weight ..	0	18
638	Soap, fine, with or without perfume, gross weight ..	1	25
640	Spermaceti, net weight ..	0	40
676	Stearine, net weight ..	0	14
	Tallow of all kinds, gross weight ..	0	07

By legal weight is understood the weight of the merchandise, including that of the inner coverings, such as bottles, boxes, wrappers, etc.

TRADE BETWEEN SPAIN AND THE UNITED KINGDOM.

1. Imports from Spain.

	VALUE.	Oct. 1885.	Oct. 1886.
Chemical Products, unenumerated	£5,912 ..	£1,396	
Pyrites of iron and copper { quantity tons ..	18,354 ..	29,611	
{ value in £ ..	93,905 ..	55,880	

2. Exports to Spain.

Alkali { quantity cwt.	22,681 ..	23,636	
{ value in £ ..	8,562 ..	7,725	
Cement { quantity cwt.	7,300 ..	21,300	
{ value in £ ..	685 ..	1,874	
Grease, { quantity cwt.	1,918 ..	1,143	
Tallow, { value in £ ..	2,247 ..	1,136	
Fat ..			
Oilseed { gallons ..	10,400 ..	11,100	
{ value in £ ..	979 ..	920	
Oil, other sorts—value in £ ..	1,237 ..	353	
Soap { quantity cwt ..	916 ..	597	
{ value in £ ..	763 ..	493	

Iron Ore Exported from Bilbao.

	Tons.
From January 1 to December 10, 1886	2,940,397
" " " 1885	3,149,870
" " " 1884	2,981,337

SUGAR BOUNTIES IN RUSSIA.—A telegram, dated the 3rd December last, has been received from Sir R. B. D. Morier, Her Majesty's Ambassador at St. Petersburg, to the effect that the payment of bounties closed on the 1st July last on all sugar, except that exported to Central Asia. This year's crop will therefore receive no bounty.

CUBAN SUGAR CROP OF 1886-87. The following information, respecting the prospective sugar crop in Cuba, is extracted from a report by Her Majesty's Consul-General at Havana, dated the 30th October last:—

"Accounts received from the sugar-producing districts in all parts of the island tend to the conclusion that the sugar crop of 1886-1887 will be one of the largest hitherto gathered, and the probable result of the grinding is confidently expected to produce at least 800,000 tons, a figure not hitherto reached in the sugar annals of Cuba.

"This calculation is necessarily subject to climatic disturbances, and should prices at New Year not rise somewhat, or even maintain themselves at their present level, this abundance will hardly enable planters to recover from the effects of previous bad years."

GERMANY—CONDITION OF SUGAR INDUSTRIES.—"The sugar manufactories are mostly in the hands of companies which control large amounts of capital, and only a few establishments are in possession of agricultural associations. Up to the present date the Government has refunded to the manufacturers the entire duties collected on export sugar, and for this reason their dividends have been large; but farmers who produce the beets do not seem to have been benefited by this liberal measure, as the price of sugar beets has been trending steadily downward.

"Farmers are, however, growing wise by experience, for they have learned that the conversion of their sugar-beet crops into beef, by feeding them to cattle, is a much more profitable transaction than selling them for sugar purposes at present prices, and the result will be probably an advance in the price of sugar during the next two or three years."

PETROLEUM INDUSTRIES OF RUSSIA.—The *Moniteur des Intérêts Matériels* of the 31st October last has an article on the petroleum industry on the shores of the Caspian Sea. It states that there are now no less than 200 refineries of petroleum in the neighbourhood of Baku, the principal port of this district, and that the exportation of mineral oil is increasing regularly and with great rapidity. The amount of petroleum exported from Baku in 1876 was 50,000 tons; in 1885, 993,000 tons were exported. When the difficulty of bringing the oil to the sea has been completely surmounted, the trade of Baku is likely to attain very vast proportions. Large sums have been voted by the Russian Government for the improvement of the chief ports of the Black Sea, and there is every reason to expect that in a short time we shall see the mineral oils of the Caucasus drive the American oils out of a great part of the European market.

TRADE STATISTICS FOR NOVEMBER, 1886.

The Board of Trade Returns for November show the following figures:—

	Nov. 1885.	Nov. 1886.
Imports: Total value.....	£29,713,768	£33,050,955
Exports: ".....	16,464,250	17,569,692
Foreign and Colonial produce (partly estimated).....	3,918,589	3,869,976

Below are the details affecting Drugs and Chemicals:—

Imports.

	Nov. 1884.	Nov. 1885.	Nov. 1886.
Chemical manufactures and products (unenumerated).....	value £ 114,312	112,850	93,663
Alkali.....	cwt. 7,834	4,643	6,763
".....	value £ 8,165	3,827	5,644
Brimstone.....	cwt. 59,467	57,219	91,900
".....	value £ 15,244	11,110	21,117
Nitre (nitrate of soda).....	cwt. 220,956	248,265	78,010
Nitre (nitrate of soda).....	value £ 108,202	134,721	34,935
Nitre (nitrate of potash).....	cwt. 21,231	22,566	20,300
Nitre (nitrate of potash).....	value £ 21,986	19,906	17,655
Quicksilver.....	lb. 60,000	35,554	75,300
".....	value £ 4,180	3,634	6,885
Dyes and tanning materials:—			
Bark (for tanners' or dyers' use).....	cwt. 33,246	23,259	25,636
Bark (for tanners' or dyers' use).....	value £ 15,660	7,752	9,804
Aniline dyes.....	" 21,735	18,038	25,307
Alizarin.....	" 18,056	29,151	19,836
Other coal-tar dyes.....	" 376	—	—
Cochineal.....	cwt. 1,218	1,808	1,975
".....	value £ 7,406	10,980	12,633
Cutch and gambier.....	tons 1,777	1,360	2,601
".....	value £ 37,713	31,412	57,725
Iodigo.....	cwt. 1,329	3,759	2,123
".....	value £ 34,593	69,447	45,488
Madder, madder root, garancine, and munjeet.....	cwt. 1,963	2,471	856
Madder, madder root, garancine, and munjeet.....	value £ 2,672	3,612	1,072
Valonia.....	tons 676	1,621	1,800
".....	value £ 10,383	25,868	26,238
Oils:—			
Cocoa-nut.....	cwt. 38,878	8,808	23,579
".....	value £ 62,435	12,513	31,611
Olive.....	tons 769	1,461	1,306
".....	value £ 32,824	58,950	48,468
Palm.....	cwt. 72,241	84,212	80,757
".....	value £ 110,926	93,452	81,840
Petroleum.....	gals. 4,781,374	7,442,816	8,278,727
".....	value £ 110,060	229,232	239,247
Seed, of all kinds.....	tons 1,370	1,562	1,395
".....	value £ 41,448	43,261	36,162
Train, blubber, and sperm.....	tons 1,918	1,501	1,187
Train, blubber, and sperm.....	value £ 55,860	41,927	25,323
Turpentine.....	cwt. 27,534	30,444	41,941
".....	value £ 32,083	40,160	51,551

Exports.

	Nov. 1884.	Nov. 1885.	Nov. 1886.
British and Irish produce:—			
Alkali.....	cwt. 525,661	579,160	552,584
".....	value £ 168,801	168,839	169,147
Bleaching materials.....	cwt. 159,835	127,071	145,143
".....	value £ 61,013	41,889	49,950
Drugs and medicinal preparations.....	72,808	78,313	64,591
Oil (seed).....	gals. 886,700	1,410,800	1,519,600
".....	value £ 83,577	130,174	130,889
Soap.....	cwt. 41,928	30,291	37,787
".....	value £ 46,442	33,185	39,720
Painters' colours and materials (unenumerated).....	value £ 91,199	95,163	106,019
Chemicals (unenumerated).....	14,447	17,886	10,328
Cochineal.....	cwt. 758	1,217	1,341
".....	value £ 4,961	8,253	9,162
Cutch and gambier.....	tons 18,004	28,330	20,363
".....	value £ 11,706	3,917	12,178
Oils, cocoa-nut.....	cwt. 18,069	5,895	18,130
".....	value £ 145	188	144
" olive.....	tons 7,136	9,957	5,880
".....	value £ 24,805	28,510	50,676
" palm.....	cwt. 39,219	36,383	49,275
".....	value £ 40,102	45,023	51,071
" petroleum.....	gals. 1,506	1,785	2,176
Quicksilver.....	lb. 325,081	145,696	248,281
".....	value £ 24,100	11,406	23,256
Nitre (nitrate of potash).....	cwt. 2,135	5,719	389
Nitre (nitrate of potash).....	value £ 1,923	4,646	318

PRUSSIAN MINERAL STATISTICS FOR THE YEAR 1885.—The year 1885 seems, by the reports just printed of the mineral production, to have been a very favourable one throughout. With the exception of iron ores, iron pyrites, and salt, there has been an increased production of nearly all minerals and ores over the amount produced in 1884. The decrease in iron ores is considerable, amounting to 260,000 tons. The production of manganese ores, however, was nearly double the yield of 1884, and nearly quadruple that of 1883 and 1882. While the iron ores mined during the year were less than in 1884, the amount of pig iron produced shows an increase of 46,000 tons, having, however, a value of nearly nine million marks less than the total product of 1884.

All the other metals produced show considerable decline in values for the year. While there is a total increase of production equal to nearly 43,000 tons, there is a decrease in the total value of metals produced amounting to over fourteen million marks.

The number of hands employed during the year in the Prussian mines, above and below ground, amounted to 292,713. The number of fatal accidents was 841, or 2·873 per thousand, as against 2·419 per thousand in 1884. This is also a considerable increase in the death rate by accidents over the average of the last eighteen years, which was 2·5 per thousand.

Production of Minerals and Ores in the Kingdom of Prussia for the year 1885:—

	No. of mines worked.	Production.	
		Tons.	Kilos.
I. Mineral coals and bitumen:			
Stone coal.....	388	65,879,004	..
Lignite.....	428	12,387,284	..
Asphalt.....	4	19,401	..
Petroleum.....	8	2,695	..
II. Mineral salts:			
Rock salt.....	5	205,492	13 ³
Kainit.....	1	195,391	423
Other potash salts.....	1	520,339	261
Kieserit and Glauber's salt.....	..	27	..
Boracite.....	..	121	65
III. Ores:			
Iron ores.....	573	3,925,783	375
Zinc ores.....	64	679,787	713
Lead ores.....	107	110,336	782
Copper ores.....	18	611,336	713
Silver and gold ores.....	1	58	727
Cobalt ores.....	1	28	800
Nickel ores.....	2	10	767
Antimony ores.....	1	3	500
Arsenic ores.....	3	1,187	..
Manganese ores.....	39	11,696	480
Iron pyrites.....	11	115,195	12
Other sulphides and aluminates.....	2	5,153	..

IV. Salts obtained from brines :

Salts	35	255,516	642
Chloride of potash	12	73,555	377
Chloride of magnesia .....	..	7	500
Glauber's salts	6	43,767	355
Sulphate of potash	3	15,378	662
Alkaline sulphate of magnesia .....	..	20,156	616
Sulphate of magnesia .....	..	15,843	16
Sulphate of alumina	3	10,562	900
Alum	4	1,850	790

Table showing the production of furnaces and smelting works in the Kingdom of Prussia, for the year 1885:—

PRODUCT.	No. of works run.	Amount produced.		Material and on- consumed ex- clusive of fuel, tons.
		Tons.	Kilos.	
Charecoal pig iron	12	31,357	149	81,262
Coal and coke pig iron	70	2,633,537	380	7,949,292
Zinc	31	128,911	369	663,073
Pig lead	20	87,216	403	272,482
Litharge	1	3,126	420	..
Ingot copper	10	17,223	660	709,705
Black copper	3	312	801	..
Silver	17	195,034	474	3,460
Gold	6	130	02	..
Nickel	12	144	196	..
Cobalt	2	33	640	373
Cadmium	10	2,267	..	..
Tin (salts)	12	120	367	..
Metallic manganese	1	6	700	11
Antimonial alloys	1	118	753	409
Metallic antimony	1	..	250	1
Arsenates	3	521	788	2,086
Sulphur	11	3,189	750	705
Sulphuric acid	56	245,472	12	186,867
Oil of vitriol, 60 deg.	3	8,618	560	7,042
Sulphate of iron	17	4,800	946	562
Sulphate of copper	5	2,587	317	1,375
Mixed sulphates	12	234	113	272
Sulphate of zinc	12	683	430	..
Others	12	161	..	85

* Kilograms. † Per kilogram.

PROGRESS OF THE BASIC OR THOMAS-GILCHRIST PROCESS FOR THE TWELVE MONTHS ENDING OCTOBER 31, 1886.—The total make of steel and ingot-iron from phosphoric pig during this period amounts to 1,313,631 tons, being an increase over the make for the previous twelve months of about 368,314 tons. It is noticeable that of this make no fewer than 927,281 tons were ingot iron containing under 0.17 per cent. of carbon. The makes of the various countries for the 12 months ending September 30, 1885, and October 31, 1886, respectively, are as follows:—

	1885.		1886.	
	Total.	With under 0.18 p. cent. Carbon.	Total.	With under 0.17 p. cent. Carbon.
England	Tons. 115,707	Tons. 70,813	Tons. 258,166	Tons. 161,908
Germany, Luxemburg, and Austria	617,514	424,862	883,859	651,523
France	130,582	62,350	122,711	77,111
Belgium and other countries.	51,514	42,118	48,595	36,712
Totals	945,317	600,183	1,313,631	927,284

It is noteworthy that these 1,313,631 tons of steel represent about 394,000 tons of slag, containing from 30 per cent. to 35 per cent. of phosphate of lime. Nearly all the basic slag made in Germany is very finely ground, and used in place of super-phosphates.

COPPER PRODUCTION IN RUSSIA.—Since the discovery of copper in Chili, Australia, and America, the production of copper in Russia has gradually fallen off. Thus, in 1856, Russia supplied the Continent with 2570 tons of copper, and imported only some 50 tons. Now, of every 100kilos, used in Russia 75 per cent. is of foreign production. At present the metal is chiefly raised in the Elizabethopol district of Transcaucasia. There are two works there, owned by the Brothers Siemens, and they get their ore from six shafts in Mount Misdag. The ore varies in richness from 2 to 20 per cent. In the period from 1876 to 1881 these two works produced from 18,070 tons of ore 3209 tons of copper. The workmen number 1500, and they are paid at from 30 to 40 copeks per day. Owing to the results obtained being regarded as satisfactory, a spur has been given to the development of production in the Government of Tiflis. Ore exists in some districts there yielding metal of an average value of 16 per cent.—*European Mail*.

Monthly Patent List.

1.—GENERAL PLANT, APPARATUS, AND MACHINERY.
APPLICATIONS.

- 15215 H. J. Allison, London.—From J. H. Blessing, United States. Improvements in apparatus for purifying water. Complete specification. November 23
- 15216 H. J. Allison.—From J. H. Blessing. Water purifying apparatus. Complete specification. November 23
- 15218 W. W. Beaumont, London. Supplying fresh feed water to steam boilers of surface condensing engines. November 23
- 15220 S. Harrison, Ripon. Regulating outlets of reaction turbines. November 23
- 15208 A. J. Boulton, London.—From N. Carvalho, United States. Improvements in apparatus for heating air, steam, or the like. Complete specification. November 23
- 15292 G. Westinghouse, jun., and F. Moore, London. Improvements in thermostats. Complete specification. November 23
- 15293 G. A. Godillot, London. Improvements in revolving fire grates for furnaces. November 23
- 15350 H. Bamford, London. Valves for controlling the flow of water, steam, compressed air, or other fluids or gases through pipes. November 21
- 15104 H. W. Cole and A. F. Cole, London. Improvements in or relating to gas and other fluid pressure controlling apparatus. November 25
- 15410 T. S. Marriage, London. Metallic vessels for holding liquids. November 26
- 15479 M. Vining, London. Apparatus for facilitating the use of compressed air or other gases or vapours for imparting pressure to water for extinguishing fires and for other purposes. November 26
- 15456 J. Henderson, Wakefield. Improved furnace or grate bars. November 27
- 15520 W. J. Clark, London. An apparatus for automatically regulating the supply of air to furnaces under forced draught. November 27
- 15550 F. J. Ricarde—Seaver, London. Linings for furnaces, retorts, crucibles, and the like. November 29
- 15558 R. Fraser and J. B. Edmiston, Liverpool. Improvements in or appertaining to forced draught apparatus for furnaces. November 29
- 15505 D. B. Morison, Hartlepool. Artificial air supply to boiler furnaces. November 30
- 15536 W. H. Mirfin, London. Improvements in or applicable to steam boiler or other furnaces. November 30
- 15604 A. J. Boulton, London.—From J. L. W. Oesen, Denmark. Apparatus for indicating the level in steam boilers and the like. Complete specification. November 30
- 15715 J. Joly and J. Bochon, London. Machinery or apparatus for granulating or disintegrating coke and other materials. Complete specification. December 1
- 15751 J. B. Fenby, Sutton Coldfield. Cocks and valves for controlling the flow of liquids. December 2
- 15757 R. Fraser and J. B. Edmiston, Liverpool. Improvements in or appertaining to forced draught apparatus for furnaces. December 2
- 15768 O. J. Ellis, London. Air refrigerating machines. December 2
- 15787 H. Wilson, Stockton-on-Tees. Apparatus for creating forced draught and forced combustion, for injecting fuel into furnaces and the like, applicable to steam-boiler and other furnaces. Complete specification. December 3
- 15812 A. Blechynden, London. Centrifugal fans for extracting or forcing air. December 3
- 15861 H. C. Simpson and E. W. Astle, Derby. Construction of boilers for heating purposes. December 4
- 15872 W. W. L. Lishman, J. T. Lishman, and W. R. Bootland, Liverpool. Condensers used in the analysis of chemicals. December 4
- 16029 C. Marquis de Montgrand, London. Process and apparatus for the production of heat and cold. December 7
- 16067 A. A. Rickaby, London. System of promoting circulation of water in steam boilers, and preventing the deposit of scale on furnaces or other parts exposed to heat. December 8
- 16135 E. Kaselowsky, London. Apparatus for pumping and compressing air. Complete specification. December 9
- 16227 F. J. Browne, London. An improved smoke consumer. December 11
- 16263 W. R. Dennis, London. Improvements in heating apparatus. Complete specification. December 11
- 16277 E. Seger, London. Improvements in centrifugal apparatus. Complete specification. December 11
- 16290 J. B. Hannay, Glasgow. Apparatus for condensing, absorbing, or washing gases or fumes, and for similar purposes. December 13
- 16375 G. S. Follansbee, London. Improvements in fluid meters. Complete specification. December 14
- 16401 G. P. Bradford, Haney. The prevention of sulphurous fumes from the use of coke for firing on tramway or other engines and in the manufacture of iron. December 14
- 16411 W. W. Popplewell, London.—From J. Trueb, United States. Thermometric regulators for heating apparatus. Complete specification. December 14
- 16433 D. Rylands and R. Potter, Barnsley. Construction of port mouths of regenerative gas furnaces. Complete specification. December 15

- 16325 F. W. Bond, London. Apparatus for heating liquid by steam. December 16
 16332 H. P. Miller, London. Gas heating apparatus. December 16
 16333 W. Richardson and J. Fidler, Manchester. Machines or apparatus known as "Steel tape condensers." December 16
 16317 J. Atkinson, London. Improvements in refrigerating apparatus. December 17
 16389 E. L. Marsden and P. H. S. Nicklin, London. Improvement in steam blast apparatus. December 17
 16392 T. Milburn, C. W. Haydon, and E. Mundy, Manchester. Furnace grates having movable bars. December 17
 16393 S. Bennett, London. Apparatus for purifying water for boilers. December 17
 16611 B. J. Davenport, Birmingham. Gauge for indicating the depth of water or other liquid in an elevated tank or other receptacle. December 18
 16618 C. Vaughan, Shetfield. Clacks or valves for pumps and appliances for raising water and other liquids. Complete specification. December 18
 16721 T. S. Webb, London. Apparatus for heating water and other liquids. December 20

COMPLETE SPECIFICATIONS ACCEPTED.*

1886.

- 682 J. C. Brentnall. Steam generator and other furnaces. December 17
 1210 H. J. H. King. Mercurial gauges. November 30
 1213 A. Fould and P. Genéan. Refractory bricks, tiles, tubes, crucibles, furnace linings, etc., to be subjected to high temperatures. November 30
 1391 H. Mans. Apparatus for feeding furnaces without admitting air. November 30
 1439 J. Atkinson. Pumps for compressing or exhausting air or other gases. December 3
 1990 J. Maclear—From J. Kolb. Raising liquids and apparatus therefor. December 7
 2075 A. Sweet. Water heating apparatus. December 17
 2086 P. A. Maignen. Purifying and softening liquids, and apparatus therefor. December 11
 2176 J. Dewrance. Duplex water ganges for boilers. December 17
 2962 J. A. Muller. Apparatus for measuring and registering currents of fluids or gases. December 17
 8375 W. C. Nickels. Filtering funnels. December 17
 13116 J. McEwen. Signal employed in carbonic acid gas generators. November 26
 13671 D. McColey Weston. Centrifugal machines. November 26
 14162 H. T. Varyan. Vacuum distillation apparatus. December 3
 161616 W. E. Gedge—From J. E. Carroll. Apparatus for heating and purifying feed water for boilers. December 11
 161690 A. M. Clark—From C. S. Wilcox. Means for effecting consumption of smoke in furnace. December 11
 11887 D. George. Creating a draught in boiler flues or chimneys. December 17

H.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

- 15227 G. Pettigrew and G. Harper, Sligo. An improved system of injecting and regulating the flow of tar, oil, or other liquid fuels into furnaces for heating gas retorts, steam boilers, and other purposes. November 23
 15287 J. S. Sellon, London. Improvements in apparatus to be employed in lighting and heating. Nov. 23
 15301 W. Wells, Glasgow. Improvements in apparatus for obtaining light from hydrocarbons. November 21
 15328 R. Wallwork, London. Improvements in burners for generating gas from oils or combustible liquids, and burning the same to produce light and heat, and in apparatus connected therewith. November 21
 15456 C. Appleby, London. Heating chambers or closets. November 26
 15478 F. Lux, London. The purification of illuminating gas and other liquids, and apparatus therefor. Complete specification. November 26
 15481 J. Horrocks, Southport. Improvements in gas and electric light lamp pillar, and other illuminating pillars, and the means of effecting the same. November 27
 15560 J. Schweizer and P. E. Huber, London. Apparatus for lighting and heating with petroleum or other substance. November 29
 15621 B. H. Thwaite, Liverpool. Improvements in methods of generating gaseous fuel, and in apparatus therefor. November 30
 15716 S. Cutler, London. Apparatus for the distribution of liquid in gas scrubbers. December 1
 15728 F. J. Jones, London. Method of and apparatus for producing or manufacturing gas for illuminating and other purposes. December 1

- 15742 D. Ballardie, Glasgow. Burners for lamps to burn solid paraffin, naphthalene, or such oils or hydrocarbons as freeze or solidify at a low temperature. December 2
 15771 G. T. Budd, Plymouth. Lighting or resuscitating fires (domestic or otherwise), by employing gas instead of paper and wood or other quick combustible. December 2
 15839 T. Fletcher and A. Clare, Manchester. Improvements in and connected with gas fires and gas stoves. December 1
 15902 H. H. Lake, London—From J. J. Johnston, United States. Manufacture of gas for lighting and heating purposes. December 1
 15974 A. McDougall, Penrith. Treating coal or coke to improve its qualities for heating, smelting, or gas making, also to diminish the smoke evolved in the combustion of coal. December 7
 15991 C. J. Sandahl, J. Birchall, and J. Musson, Liverpool. Process of manufacturing gas, and apparatus employed therein. December 7
 16029 C. Marquis de Montgrand. See Class I.
 16018 A. Thomas, West Cowes. An improved means for straining gas-tar to be used as fuel in gas and other works. December 8
 16053 B. H. Thwaite, Liverpool. Methods of producing combustible gases from liquid hydrocarbons, and in apparatus therefor. December 8
 16112 F. B. Fowler, London. Improvements in the mode of and means or appliances for making oil-gas. Complete specification. December 9
 16380 T. W. Bayes, London. Apparatus for drying washed coal, or coal partially prepared for the manufacture of artificial fuel, applicable also to drying other materials. December 11
 16431 W. Wilkie, Glasgow. Improvements in preventing smoke by increasing the draught in chimneys, the said improvements being also applicable for supplying or discharging heated air into rooms or other apartments for heating and ventilating purposes, as well as for disinfecting the same. December 15
 16531 H. Arch, Leeds. Preparing smithy coke. December 17
 16581 A. Paget, Loughborough. The use and construction of "mantles" for incandescent gas lighting. December 17
 16657 W. Defries, London. Improved means of distributing light by reflection. December 18
 16727 W. Boggett, London. Obtaining heat and light, and apparatus employed therefor. December 20

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 15291 J. Butterfield. Means for increasing the temperature of furnace gases and air heated thereby. November 30
 15331 A. Kinnear and E. Fahrig. Apparatus for carburetting and increasing illuminating power of gas. December 10
 16052 W. Young. Purification of coal-gas, and apparatus therefor; in part applicable for preparation of caustic ammonia solutions. December 7

1886.

- 603 S. Banner. Manufacture, blending, and treatment of certain mineral hydrocarbons or compounds thereof. December 11
 1226 J. West. Apparatus for charging and drawing gas retorts. November 26
 1459 J. L. Balfour and J. Lane. Manufacture of illuminating gas and volatile liquid hydrocarbons. November 26
 1891 J. W. Brewster. Apparatus for regulating the temperature of, and supplying heating or cooling media to rooms, etc. December 10
 2299 H. Fournier. Stop valves for regulating admission of gas, etc., to burners of illuminating apparatus. December 17
 2307 H. Barclay and R. Simpson. Manufacture of coke for metallurgical purposes. November 30
 2411 A. Kempster. Centre valves for working purifiers, etc., used in the manufacture of coal-gas. December 17
 2892 H. Bowater. Purification of coal-gas. December 10
 11691 G. R. Cottrell. Method and apparatus for carburetting and mixing gas and air. December 7
 13227 W. H. Hawkes. Compound for treating coal and other fuel. December 2
 11795 J. F. Wright and G. E. Wright. Waste heat extractors for gas fires. December 17

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, ETC.

APPLICATION.

- 15772 R. B. Tement, Glasgow. Destructive distillation of shale and other minerals, and retorts therefor. December 2

COMPLETE SPECIFICATION ACCEPTED.

1886.

- 8191 R. Tervet. Apparatus for distilling or refining mineral oils. December 17

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

- 15576 C. Collin and L. Errani, London. Black liquid prepared from aniline, nitro-benzene, and from their derivatives, for dyeing, printing, painting, and varnishing on all kinds of materials. November 30
 15651 H. Hirsch and J. Dawson, London. A process for obtaining chloride and bromide of amidodimethylaniline, and producing dyes therefrom. November 30
 16258 W. P. Thompson, Liverpool—From Ewer and Pick, Germany. Manufacture of aromatic diamines, and of azo-dyes, and derivatives therefrom. December 11

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

- 2213 C. A. Martins. Production of mixed azo-colours. December 3
 2878 A. M. Clark—From A. Müller-Jacobs. Manufacture of colouring matters, and vehicle therefor. December 14
 3890 T. Carnelley. Preparation of para-amido-diphenyl-sulphonic acid. December 10
 13780 C. D. Abel—From the Actiengesellschaft für Anilin-Fabrication. Production of azo-colours from orthosulpho or orthocarbo acid of benzidine. December 3

V.—TEXTILES: COTTON, WOOL, SILK, ETC.

APPLICATIONS.

- 15283 T. Zebrowski. See Class VI.
 15313 W. Mather, London. Apparatus for treating textile materials with liquids, gases, or vapours. November 24
 15399 J. B. Whiteley and W. Whiteley, Halifax. Machinery for drying wool and other fibre. November 30
 15600 J. B. Whiteley and W. Whiteley. Machinery for washing and scouring wool and other fibrous substances. November 30
 15669 G. Jagenburg, London. Machine for washing cotton and other textile materials. Complete specification. November 30
 15714 W. Pfirsch and B. Kirchner. See Class XIX.
 16066 A. Morel, Liverpool. Apparatus for treating wool and other fibrous materials for the removal of burrs therefrom. Complete specification. December 8
 16078 E. Casper, London. Treating the barks of ilea or China-grass, and like plants; and apparatus therefor. December 8
 16116 H. H. Lake, London—From H. R. Randall, United States. Improvements relating to the treatment of silk and other fibres. Complete specification. December 14
 16714 G. S. Patullo, Glasgow. Treating or preserving jute and other similar fibres. December 20

COMPLETE SPECIFICATION ACCEPTED.

1886.

- 1939 H. H. Doty. See Class XIX.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

- 15273 H. H. Leigh, London—From J. G. Watmough, United States. Improvements in apparatus for dyeing. November 26
 15283 T. Zebrowski, London. Improvements in the method of, and apparatus for, washing, scouring, and bleaching wool. November 23
 15355 T. O. Arnfield, Manchester. Improved apparatus to be employed in soaping, scouring, and cleansing printed and dyed fabrics. November 25
 15363 D. Stewart, Glasgow. Preparing and applying grey and black colouring matters to textile fabrics and materials. November 25
 15122 E. Edwards, London—From L. Gevaert, Belgium. Process for dyeing blue by means of alizarin. November 26
 15435 R. Holt, Halifax. Method and apparatus for dyeing warps of Turkey red, alizarin red, and other fancy colours. November 26
 15611 C. Gaydet, London. Apparatus for printing colours on hanks, yarns, or pieces of textile material. November 30
 15824 J. B. Alliot and J. Wade, London. Method of fixing colour upon printed yarns or other material, and in the apparatus employed therefor; parts of the improved apparatus being also applicable to other purposes. December 3
 16112 L. Weldon, London. Improvements in dyeing apparatus. Complete specification. December 14
 16143 E. Sutcliffe and G. E. Sutcliffe, Halifax. An improved means or method of drying dyed slivers of fibre. December 15
 16596 C. Carron, London. Machine for dyeing hanks or skeins of textile materials. Complete specification. December 17

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

- 211 J. C. Munn. Production of piece-dyed goods. December 3
 1465 H. Horner—From C. C. Sabin. Blueing water for laundry and other purposes, and apparatus therefor. December 3
 1482 J. Conlter. Hawking machines for indigo dyeing. December 3
 1750 W. G. White. Dyeing fabrics, and apparatus therefor.
 15388 J. Fletcher. Dyeing tissue and other papers, and apparatus therefor. December 7

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

- 15286 J. J. Hood and A. G. Solomon, London. Improvements in the manufacture of manganese sulphate. November 23
 15352 W. Burns, Leith. Manufacture of bicarbonate and carbonate of soda by the ammonia process, and construction and use of apparatus for that purpose. November 25
 15391 A. A. Croll, London. The distillation of ammoniacal liquors, the concentration of liquids and salts in solutions, and means or apparatus employed therein. November 25
 15436 H. Byk, London. Process for manufacturing tannic acid in bright, semi-transparent or translucent crystals or grains. Complete specification. November 26
 15488 W. Burns, Leith. Manufacture of sulphate of soda and bleach in one operation under high pressure, and in the construction and use of apparatus for that purpose. November 27
 15498 W. Branley and W. P. Cochrane, Redcar. Treating solutions of chloride of calcium so as to obtain chloride of magnesium and other products. November 27
 15793 J. S. Rigby, Holywell. Treatment for utilising a residue from the manufacture of caustic soda or caustic potash, commonly termed lime-mud. December 3
 15897 W. P. Thompson, Liverpool—From H. Reimann, Germany. Production of chlorine from chlorides of the alkalis and alkaline earths, and treatment of pyrites residues for the extraction of copper and other metals therefrom. December 7
 16022 G. Eschellmann and K. Markel, Liverpool. Manufacture of caustic soda or caustic potash and carbonic acid from carbonate, sesqui carbonate, or bicarbonate of soda, or carbonate or bicarbonate of potash. December 7
 16118 H. Kenyon, Manchester. Production of sulphide of zinc and chloride of ammonium. December 9
 16191 J. M. Walton, Manchester. Manufacture of sulphurous acids and other sulphur compounds, and apparatus employed in such manufacture. Complete specification. December 16
 16199 W. B. Giles and A. Shearer, Stratford. Manufacture of phosphoric acid. December 16
 16362 G. L. Wigg, M. Steele, W. J. Wigg and W. Towns, Liverpool. Treatment of sulphate of soda to obtain alkali, and apparatus therefor. December 17
 16363 G. L. Wigg, M. Steele, and W. J. Wigg, Liverpool. Treatment of certain residual liquors obtained in copper works for the production of sulphate of iron. December 17
 16399 The Tyne Alkali Company, Limited, and T. Gibb, London. Manufacture of hydrate of baryta and strontia and salts of barium and strontium. December 17
 16600 T. Scott, Glasgow. Evaporating saline solutions, and apparatus therefor. December 17
 16712 R. McCowan Service, Glasgow. Treatment of spent liquor or alkali waste from paper mills and other works, and recovery of caustic soda therefrom. December 20

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 16052 W. Young. See Class H.

1886.

- 1939 J. Maclear. Preparing soda for sale and distribution. December 10
 16022 J. Whitley. Apparatus for manufacture of acids and distillation and condensation of corrosive liquid and gaseous substances. December 10
 13116 J. McEwen. See Class I.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

- 15310 W. H. Turner, London. Machines for printing designs upon paper or other material, especially applicable to the decorating of earthenware, china, glass, tiles, granite, and the like. November 21
 15579 H. J. Allison, London—From C. C. Gilman, United States. Manufacture of porous earthenware. Complete specification. November 30
 15988 H. P. Dunnill and F. R. Smith, Iron Bridge, Salop. Method or means of manufacturing or producing constructions in tiles or any other similar articles. December 7

- 16009 G. F. Chance, London. New or improved machinery for rolling glass. December 7
 16229 E. Lee, Leeds. An improved process, mode, or means of ornamenting and utilising glass or other hard substances by sand blasting. December 11
 16268 J. Armstrong, London. Blowing and moulding glass, opal, etc., and machinery and appliances therefor. Dec. 11
 16365 A. D. Brogan, Glasgow. Improvements in kilns for annealing glass. December 11
 16366 A. D. Brogan and A. M. Malloch, Glasgow. Improvements in the manufacture of rippled glass, and in apparatus therefor. December 11
 16500 J. P. Guy, Longport. Improvements in machinery for making potters' seggars. December 16
 16555 H. Sulley, Nottingham. Improvement in the manufacture of pavement lights, and an improved method of fixing glass in metal frames. December 17
 16613 J. Northwood, London. Method of treating the glass cullet, known as "blacks." December 17

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

- 801 J. Scott, Manufacture of rolled plate glass, and apparatus therefor. December 17
 2073 G. Lazenby. Kilns for bending glass, firing stained glass, tiles, pottery-ware, etc. December 7
 11330 W. Boulton. Manufacture of articles of pottery having straight parallel sides. December 7

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

- 15211 G. Weston, Sheffield. An improved composition for preventing disintegration of roads and footpaths. Nov. 23
 15317 L. Schlenheim, London. An improved method of making ornamental granite marble mosaic. November 25
 15473 J. Winkler, London. A drop press for moulding building blocks. November 26
 15965 C. J. Dobbs, London. An improved construction of paving with moulded slag blocks. December 6
 16180 W. Joy, London. Improvements in and connected with the manufacture of Portland cement and natural cement, or hydraulic lime and other lime, and in apparatus therefor. December 15

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

- 11619 T. C. Fawcett and J. D. Fawcett. Machinery for pressing bricks, tiles, etc. November 26

1886.

- 2399 H. Faija. Apparatus for mixing concrete. Dec. 17
 2171 E. W. Collier. Drying slurry, etc., and apparatus therefor. November 30
 10829 C. J. Dobbs. Manufacture of scoria paving blocks. November 30
 11131 G. Howard. Decorating wood. December 11

X.—METALLURGY, MINING, ETC.

APPLICATIONS.

- 15216 F. B. Felt, London. Improvements in the manufacture of iron bars, plates, and similar articles. Complete specification. November 23
 15270 F. A. Herbertz, London. Improvements in cupola smelting furnaces. Complete specification. November 23
 15308 C. W. Crossley, London. Improved apparatus for the separation, extraction, and amalgamation of metals. Nov. 24
 15320 H. A. Stuart and C. R. Binney, London. Improvements in machinery for coating metallic sheets or plates with other metal alloys. November 24
 15322 E. C. Kleiner-Fiertz, London. Improvements in and connected with the manufacture of aluminium and other light metals. November 24
 15357 J. T. King, Liverpool—From D. Brose, United States. Improvements in making steel. Complete specification. November 25
 15403 A. J. Boulton, London—From La Société Anonyme de Metallisation Artistiques des Animaux, Vegetaux, ou Autres Corps, France. Preparation of organic matter for metallisation by galvanic deposit
 15476 A. Wilson, London. Manufacture of compound armour-plates. November 26
 15477 E. Morewood, Llanelly. Coating with tin, or other coating metal, sheets, plates or pieces of iron or other metals. November 26
 15515 C. Appleby, London. Machinery or apparatus for reducing to powder mineral ores or other hard substances. November 27
 15534 A. E. Tucker and F. W. Harbord, Smetbwick. Improvements in materials used in the construction of metallurgical furnaces and converters. November 29
 15535 R. Dixon, Stockton-on-Tees. Apparatus for purifying coal or the like material by the washing process. November 29

- 15550 F. J. Riearde-Seaver, London. Linings for furnaces, crucibles, retorts, and the like. November 29
 15591 W. Hlawdon, Middlesbrough. Apparatus for removing and disposing of the slag of blast furnaces. November 30
 15710 L. R. Forbes, London. Construction of armour for ships and other vessels, fortifications, and defences. Dec. 1
 15740 J. Platt, Birmingham. Manufacture of nuts, and process for making iron from which to manufacture nuts. Dec. 2
 15788 T. Cossar and J. Bryce, Glasgow. Enamelling of dairy utensils made of iron or other metal with porcelain, enamel, ground glass, silica of soda, sand, and chloride of sodium. December 3
 15790 W. G. Copestake and C. Jones, Derby. Converting or reconverting old steel, iron, and other kinds of metal into compounds known generally as the different kinds of steel. December 3
 15797 G. Quick, Chipping Campden. Improvements in steel armour-plates. December 3
 15798 G. Quick. Steel armour-plates. December 3
 15804 G. W. Elliott, Sheffield. Appliances for boring and mining rock, coal, and other minerals. December 3
 15831 F. E. Elmore. See Class XVIII.
 15836 J. W. Hall, London—From F. H. Durell, United States. Improvements in ordnance. December 3
 15854 R. Scott, Newcastle-on-Tyne. Miners' safety lamps. December 4
 15879 H. F. Elkington & H. T. Fellows, jun., London. An improvement or improvements in decorating gold, silver, electro-plate, and other metal wares. December 4
 15916 C. Payen, London. Crystallisation of metals by a general method, with variable porosity, and preserving in every instance the crystalline aggregation. December 6
 15946 J. Clark, London. Obtaining alloys of aluminium with certain other metals. December 6
 15965 C. J. Dobbs. See Class IX.
 15978 E. H. Cowles, The Cowles Electric Smelting and Aluminium Co., London. Manufacture of compound armour-plates of aluminium alloys and other metals. December 7
 15987 W. P. Thompson—From H. Reimann. See Class VIII.
 16004 J. Nicholas and H. H. Fanshawe, London. Process for procuring the precious metals from their ores. December 7
 16038 K. M. Deeley, jun., Derby. Process for casting metals. December 8
 16047 G. Ashworth and E. Ashworth, Manchester. Apparatus for hardening and tempering steel wire and tape. Dec. 8
 16065 R. B. Thomas, London. Improvements in cleaning metal plates or sheets. December 8
 16109 S. F. Walker, Cardiff. Electric miners' safety lamps. December 9
 16128 E. de Pass, London—From La Société Anonyme des Mines de Fer de l'Anjou et des Forges de Saint Nazaire, France. A process of converting old steel rails into metallic sleepers for railways, tramways, and the like. December 9
 16224 E. Morewood, Llanelly. Improvements in coating with tin,terne, or other coating metal, sheets, plates, or pieces of iron or other metal. December 10
 16242 C. W. Thompson, Dulwich. Improvement in rock drills. December 11
 16271 T. Lockerbie, London. Construction of regenerative furnaces for melting iron, steel, and other metals or minerals. December 11
 16386 H. E. Newton, London—From J. J. Crooke and R. Crooke, United States. An improved process for treating and desilverising copper matte and copper ores analogous to copper matte. Complete specification. December 11
 16400 J. H. Lancaster, London. Crushing ore and rock. December 11
 16401 G. P. Bradford. See Class I.
 16419 W. A. Bariow, London—From J. Bulliat, France. New or improved means for the manufacture of fine steel from coarse grain steel (Bessemer and such like), and for the regeneration of burnt steel. December 11
 16523 J. E. Bott, S. J. Hackney, and W. Craven, London. Improvements in and apparatus for the production of steel castings, also applicable for melting copper, tin, and other metals. Complete specification. December 16
 16546 H. W. Buddicom, London. Apparatus for tinning plates. December 16
 16563 G. L. Wigg, M. Steele, and W. J. Wigg. See Class VII.
 16574 G. H. Lloyd, Sutton Coldfield, A. L. Lloyd, Leamington, and H. Bewlay, Moseley. Welding and heating, and apparatus connected therewith. December 17
 16608 D. G. Fitzgerald, London. The production of coherent masses of peroxide of lead for use as voltaic battery elements, and for use in electrolytical and metallurgical operations. December 17
 16627 J. W. Noad, P. Higgs, and J. Hobart, London. Production of aluminium. December 18
 16631 C. M. Pielsticker, London. Production of compressed metal castings. December 18
 16658 W. Elmore, F. E. Elmore, and A. S. Elmore, London. Treatment of tin scrap and the like in the obtainment therefrom of oxide of iron and oxide of tin. December 18
 16682 S. Adams, Middlesbrough. Universal mill for rolling iron and steel plates, etc. December 20

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

- 566 R. Hadfield. Production and treatment of steel. Dec. 11
 1359 J. R. Turnock. Apparatus for annealing, pickling, coating, and cleaning metal plates or sheets. December 7
 1796 T. Twynam. Purification of iron and of phosphatic ferruginous slags. December 7

1885 M. Evrard. Machinery for washing coal and other minerals. December 10
 2062 G. F. Simonds. Dies, etc., for use in the production of rolled metal articles. December 14
 2102 H. H. Lake—From Verein Chemischer Fabriken. Recovery of tin from scraps of tinned plate. December 17
 13686 J. Laidler. Miners' safety lamps. November 26
 11238 A. Schmöle. Separating the injurious ferruginous alloys of tin contained in baths for tinning iron. December 7
 14927 J. R. Whitney. "Chills" employed in casting metals. December 17

XI.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

15995 R. Wharry and G. Dyson, London. Making an odourless antiseptic soap. December 7
 16516 W. Boggett, London. Oxidising oils, and apparatus therefor. December 16

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

2178 J. Dewrance. Lubricants for steam cylinders. December 17
 11069 A. H. Allen and B. Nickels. Treatment of spent soap leys, crude glycerine, etc., for removal of impurities and recovery of glycerine and other products. December 7

XII.—PAINTS, VARNISHES, AND RESINS.

APPLICATIONS.

15561 W. Carter, London. Anti-fouling composition for ships' bottoms. Complete specification. November 29
 16429 F. W. Hayward, Norwich. Improvements in varnish. December 15

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

1086 F. Wendling. Manufacture of paint. November 26
 2310 D. Swan. Improvements in obtaining pigments. December 14

XIII.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

15158 J. Pujos, London. A process of treating membranous or interval parts of animals for the manufacture of leather therefrom. November 26
 15632 T. Palmer and L. Palmer, London. Tawing, or treating leather which has been stuffed or dressed with oleaginous substances, and apparatus employed therein. November 30
 15884 C. R. Bonne, London—From P. F. Reinsch, Bavaria. Treatment and tanning of skins, and the manufacture of a new material for tanning and other purposes. December 4
 16647 A. Bedu, London. Manufacture of novel substances suitable for tanning and for other purposes. December 18

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

1280 B. Wright. Apparatus for adjusting machines used in splitting leather, hides, and skins. November 30
 1503 J. Hall and A. Hall. Machinery for skiving, bevelling, etc., in the manufacture of leather. December 3
 2052 W. R. Earp. Manufacture of leather. December 10
 14916 E. A. Brydges. Treating and preserving hides and skins. December 17

XIV.—AGRICULTURE, MANURES, ETC.

APPLICATIONS.

15566 H. Fuchs, London. Preparation and application of a material for destroying insects that infest vines. November 29
 16039 W. H. Hartland. See Class XVII., B.
 16244 T. B. Wilson. See Class XVII., B.

XV.—SUGAR, GUMS, STARCHES, ETC.

APPLICATIONS.

15240 O. Bowen and J. Cobeldick. See Class XVII., B.
 16016 F. Scheibler, London. Moulding sugar, and apparatus employed therein. Complete specification. December 7
 16126 J. Frankenbnrg, Manchester. Manufacture of india-rubber for boot and shoe soles, belting, and similar purposes. December 15
 16142 J. Frankenbnrg. Manufacture of india-rubber for boot and shoe soles, belting, and similar purposes, and in apparatus therefor. December 15

16603 A. J. Boulton, London—From J. De Rubio y Daza, Spain. Machines for cutting sugar-canes and the like. December 17
 16615 J. Kelly, London. Making and preparing boiled-sugar goods or sweets. December 17

XVI.—BREWING, WINES, SPIRITS, ETC.

APPLICATIONS.

15528 T. F. Wiley, Bradford—From A. Frolich and Captain Fischer, Denmark. Apparatus for charging beer and analogous liquids with carbonic acid gas, and simultaneously withdrawing such liquids from the reservoirs containing the same. November 29
 15896 W. P. Thompson, Liverpool—From S. Bensande, France. The manufacture of alcohol from manioc, or improvements relating thereto. December 4

COMPLETE SPECIFICATION ACCEPTED.

1886.

13738 H. H. Lake—From J. W. Free. Manufacture of malt, and apparatus therefor.

XVII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, DISINFECTANTS, ETC.

APPLICATIONS.

A.—CHEMISTRY OF FOODS.

15161 F. Krietsch, sen., London. Treating leguminous seeds after removal from their pods, to prevent their deterioration. November 26
 15594 W. H. Rhodes, Manchester. An improved means of preserving fruit. November 30
 16270 C. D. Abel, London—From C. Linde, Germany. A process and apparatus for making clear ice. December 11
 16320 F. Edwards, London. The preservation of fish, flesh, fowl, fruit, vegetables, syrups, cider and fruit juices, and other perishable articles of food. December 13
 16691 V. St. Lawrence Symonds, Lewdown. Preserving perishable goods while in transit. December 20

B.—SANITARY CHEMISTRY.

15222 W. Burns, Leith. Improvements in purifying sewage and other foul liquids, and in making oil, alkali, and cement from sewage precipitate, and in apparatus for that purpose. November 23
 15210 O. Bowen and J. Cobeldick, London. An improved decolorising, decolorising, and filtering medium. Nov. 23
 15341 J. Mayer, London. Improvements relating to the treatment of sewage and to apparatus therefor. November 24
 15887 W. F. Nast, London. Treatment of manure and other organic matters, and production therefrom of ammonia and residual products free from ammonia. December 4
 16039 W. H. Hartland, Glasgow. Treating sewage for the recovery and manufacture therefrom of manurial and other products, and in means or apparatus therefor. December 8
 16244 T. B. Wilson, Manchester. Treatment and purification of sewage and other impure liquids, and obtainment of fertilisers therefrom. December 11
 16181 F. D. Brown, London—From A. Howatson, Belgium. An improved method of treating sewage, and apparatus for the purpose. December 15
 16669 B. Haigh, London. Apparatus for disinfecting and decolorising closets, urinals, and the like. December 18

COMPLETE SPECIFICATIONS ACCEPTED.

A.—CHEMISTRY OF FOODS.

1886.

2501 D. Johnson and H. G. R. Davies. Means and apparatus for preserving vegetable matters to be used as food. December 7
 13742 H. H. Lake—From P. B. Rose. Manufacture of an article of food. December 3
 13758 J. Marshall and T. A. Marshall. Preparing a nutrient or digestive and medicinal substance from malt. December 3
 14472 S. Pitt—From J. M. Hughes. Mixture of salt and phosphate of lime for table use. December 11

B.—SANITARY CHEMISTRY.

1886.

10 V. L. E. Miller. Drying of sewage. November 30
 1259 S. D. Cox and J. Cox. Treatment of sewage. November 30

XVIII.—ELECTRO-CHEMISTRY.

APPLICATIONS.

15162 N. J. Raffard, London. Method and apparatus for desiccating the insulating coverings of electrical apparatus. Complete specification. November 26

15515 R. Dick and R. Kennedy, Glasgow. Improvements in and relating to the transformation and distribution of electric energy, and appliances therefor. November 29

15533 W. H. Cannon, Merton—From A. M. Richardson, United States. An improved magnetic galvanic battery. December 29

15553 H. H. Lake, London—From E. Shaw, United States. Manufacture of blocks, plates, or rods of carbon for electrical or other purposes. Complete specification. November 30

15733 R. A. Parrish, London. Method and apparatus for producing and utilising electricity. Complete specification. December 1

15762 M. Immisch, London. Electro-magnetic accessories to maritime warfare. December 2

15831 F. E. Elmore, London. Improvements in or connected with means and apparatus for the deposition or obtainment of metals by electrolysis. December 3

15837 J. A. Kingdon, London. Dynamo-electric machinery. December 3

15961 H. H. Lake, London—From Count R. de Montgela, United States. Improvements in electric batteries. Complete specification. December 6

16049 S. F. Walker, Cardiff. Improvements in galvanic batteries. December 8

16050 S. F. Walker. Improvements in dynamo-electric machines. December 8

16085 E. Jones, London. Construction of armatures for dynamo-electric machines. December 8

16110 J. C. Lemmens and H. G. Cottrell, Liverpool. Improvements in primary electric batteries. December 9

16151 W. Webster, jun., London. Improvements in primary voltaic batteries and in the preparation of the elements and solutions employed therein. December 9

16200 F. C. Phillips and H. E. Harrison, Westminster. Dynamo-electric generators and motors. December 10

16201 R. Dick and R. Kennedy, Glasgow. Improvements in and relating to the transformation and distribution of electric energy and appliances therefor. December 10

16210 J. D. F. Andrews, London. Commutating apparatus for transmitting electrical currents to and from inductors, and in commutator brushes. December 10

16211 J. D. F. Andrews. Apparatus for regulating electrical currents. December 10

16215 Sir W. Vavasour, London. Improvements in galvanic batteries. December 10

16237 L. Hendle and J. N. Moerath, London. An improvement of a primary balancing electric battery. December 11

16326 R. Dick and R. Kennedy, Glasgow. Improvements in and relating to the transformation and distribution of electric energy. December 13

16405 A. J. Boulton, London—From P. J. R. Dujardin, France. Improvements in or relating to electric accumulators. December 14

16510 M. Immisch, London. Controlling electric currents at varying speeds of a generating dynamo. December 16

16608 D. G. Fitzgerald. See Class X.

16633 J. Ryan, Newport, Monmouthshire. An instrument for use in the testing of dynamo-electric machines, electro-motors, and the like. December 18

16660 T. Mace and H. Edmunds, London. Apparatus to be employed in the manufacture or treatment of materials suitable for the filaments or incandescing media of electric lamps or for other purposes. December 18

16675 N. G. Thompson, London. Improved primary battery. December 20

16678 G. Hookham, Birmingham. Improvements in dynamo-electric machines with slotted armatures. December 20

COMPLETE SPECIFICATIONS ACCEPTED.

1885.

15251 S. Z. de Ferranti. Means for distributing electric energy. December 11

16009 R. D. Smillie. Apparatus for measuring electric currents. November 26

1886.

12 C. D. Abel—From Siemens and Halske. Volta inductors. November 26

1610 G. E. Dorman. Secondary or storage batteries. November 30

13151 J. Roper. Cover for the ends of the revolving armatures of dynamo-electric machines. December 10

13159 H. J. Haddon—From F. V. y Graells. Apparatus for regulating automatically the intensity of electric currents. December 11

15251 S. Z. de Ferranti. Means for distributing electric energy. December 11

XIX.—PAPER, PASTEBOARD, ETC.

APPLICATIONS.

15714 W. Pörsch and B. Kirchner, London. Process for the treatment of wood and other vegetable fibres. December 1

15739 H. Harford and C. F. Sutcliffe, South Shields. Improved apparatus for drying paper and other materials. December 2

15823 S. H. Hodges, London. Manufacture of paper and paper board, and apparatus to be used for this purpose. December 3

15856 H. Blackman, London. Disintegrating fibrous substances and manufacturing paper pulp, and apparatus employed therein. December 4

15898 A. E. Symonds and T. Humphrey, London. Manufacture of a solution for treating paper. December 4

16001 O. Melachrin, London. Treatment and preparation of cigarette tubes or papers. December 7

16113 J. M. Walton, Manchester. Construction of boilers for treating wood and other fibre in the manufacture of paper and other pulp. Complete specification. December 9

16538 H. Harford and C. F. Sutcliffe, South Shields. An improved apparatus for drying and finishing paper or other material. December 17

16618 W. H. Wiles, London. A preparation for the use of paper makers to prevent frothing, also stickiness on the press roll, and in which oil will assimilate. December 17

16712 R. McCowan Service. See Class VII.

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

1795 J. T. McDougall and J. McDougall. Extracting moisture from wood and other pulp. December 10

1859 H. H. Doty. Waxing paper and textile fabrics, and treating same for antiseptic purposes. December 16

2221 T. Rowland. Apparatus for pulping fibres for the manufacture of paper. December 17

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

APPLICATIONS.

15136 H. Byk, London. Process for manufacturing tannin acid in bright semi-transparent or translucent crystals or grains. Complete specification. November 26

15500 H. V. Knaggs, London. Preparations for treating skin diseases. November 27

COMPLETE SPECIFICATION ACCEPTED.

1886.

1551 O. Imray—From J. G. Smith. Manufacture from green ginger of ground ginger, ginger paste, essential oil of ginger essence of ginger, etc. December 3

XXI.—EXPLOSIVES, MATCHES, ETC.

APPLICATIONS.

15521 J. J. Masters, London. Manufacture of wax vesta matches and vesuvians, and flaming fuses with wax vesta stems. November 27

15912 C. Kellner, London. Process for the manufacture of cellulose. December 6

16081 D. Campbell and G. L. Schultz, London. Improvements in and connected with submarine mines. December 8

16196 J. Lauer, London. Improvements relating to the firing of blasting charges in mining and other operations, and to means therefor. December 10

16535 W. H. Noble, London. Manufacture of gunpowder and of gunpowder charges for guns. December 17

16622 F. J. Shand, Glasgow. Fuses for blasting and analogous operations. December 18

16656 H. E. Newton, London—From A. Nobel, France. Improvements in explosions and in the use of explosives especially in shells and torpedoes. December 18

COMPLETE SPECIFICATIONS ACCEPTED.

1886.

1955 F. Bolton. Manufacture of explosive compound and preparation of cartridges therefrom. December 11

13011 O. Imray—From G. M. Mowbray. Process and apparatus for manufacturing pyroxyline. December 7

11623 C. E. Bichel. Manufacture of explosive compounds. December 17

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